QUARTERLY JOURNAL OF METHODS AND INFORMATION FOR TEACHERS OF SCIENCE

22'46T

The SCIENCE COUNSELOR

Volume IX ★ Number 2 ★ June, 1946

DUQUESNE
UNIVERSITY
PRESS

Science Counselor.

Suspended publication
June, 1943 – March, 1946.

COORS PORCELAIN COMPANY
GOLDEN, COLORADO

The Science Counselor

"FOR BETTER SCIENCE TEACHING"

A QUARTERLY JOURNAL *of teaching methods and scientific information especially for teachers of science in Catholic schools. Published at Duquesne University, Pittsburgh, Pennsylvania, in March, June, September and December by*

THE DUQUESNE UNIVERSITY PRESS

Subscription Price: $1.00 per year; Canada, $1.25. Single copies of issues in the current year, 35c each. Business and Editorial Offices at Duquesne University, 901 Vickroy Street, Pittsburgh, Pa.

STAFF

HUGH C. MULDOON.....*Editor*
THOMAS D. HOWE...*Assistant Editor*
T. H. DUNKELBERGER *Assistant Editor*
ANDREW KOZORA....*Assistant Editor*
R. M. FUNK.....*Business Manager*

EDITORIAL COUNCIL

1946

Vernon F. Gallagher, C. S. Sp.
George A. Harcar, C. S. Sp.
Joseph P. Moroney, C. S. Sp.
Gordon F. Knight, C. S. Sp.
Brother Alphonsius, F. S. C.
Brother Alfred, S. M.
Sister M. Tarcisius, S. S. J.
Sister M. Ladislaus, H. G.
Sister M. Martin, D. P.
Sister M. Sylvester, O. S. F.
Sister M. Regina, O. S. B.
Sister M. Gabriella, O. S. F.
Sister M. Lawrence, R. S. M.
Sister M. Pulcheria, Fel.
Sister M. Hildebert, S. C.
Charles H. Becker
William Schubert
Howard Getz

Volume IX JUNE, 1946 No. 2

CONTENTS

WITH THE EDITOR..... 38

THE U. S. OFFICE OF EDUCATION SERVES SCIENCE TEACHERS..... 39
John W. Studebaker

THE ATOMIC BOMB AND WORLD PEACE..... 41
Robert J. Maurer

SCIENCE PROJECTS—WHY AND HOW..... 43
Sister M. Augustine

STREAM POLLUTION AND SOIL CONSERVATION..... 45
Francis Chilson

MARINE RESEARCH 47
Mary Frances Walter

HOW MUCH ARE PLANTS AND ANIMALS ALIKE?..... 49
Sister Mary Ellen O'Hanlon

TRAILING PREHISTORIC MAN..... 51
David W. Rial

PREDIGESTED PROTEIN NUTRITION 53
Research Staff, Wyeth Institute

THE EDUCATION OF LISE MEITNER..... 56
Hugh C. Muldoon

NEW BOOKS 58

TO OUR READERS:

¶ This issue is Volume IX, Number 2.

¶ This is the first issue since

MARCH, 1943,

when Volume IX, Number 1 was published.

With the Editor . . .

After four years of enforced quiescence *The Science Counselor* resumes publication with this issue. We are happy that the restrictions and compulsions of the war years have largely been lifted, and that our familiar orange cover will once more be seen on teachers' desks and in the libraries of schools and colleges everywhere. We are confident that our friendly journal will be welcome.

In its new journalistic life we hope to make *The Science Counselor* more attractive, more stimulating and more directly helpful to the classroom teacher than ever before. The aid of everyone who will assist in achieving this end will be gratefully received. We shall, as always, take pride in presenting articles by famous educators and scientists, but we shall also continue to seek out little known teachers and writers, particularly those who may never have published before, in the hope that we may discover and encourage hidden talent.

This journal is dedicated to the improvement of science teaching in schools and colleges, particularly in those conducted under Catholic auspices. Our aims were stated clearly in Volume 1, Number 1, published in March, 1935.

"Every teacher will agree that there is no high school—or college either for that matter—in which instruction in science cannot be improved.

"Undoubtedly there are times when teachers of science who are working under difficulties would appreciate friendly encouragement, advice and direction. They would be grateful, too, for an occasional stimulus to their enthusiasm which naturally flags at times. Teachers are always trying to increase their knowledge in their field of specialization. They realize that their educational horizons should be progressively enlarged, for their work demands breadth of learning as well as depth. Up-to-date and authentic scientific information must be sought constantly. Teachers of science should be encouraged to test new and different methods of instruction. They will gain much by learning what other science teachers are doing. In their turn they should give to others the results of their own experience. In this way it should not be difficult to arouse a group consciousness and a cordial spirit of cooperation. *The Science Counselor* hopes to help in this work. Its pages will provide a convenient medium for the exchange of information, and for the discussion of teaching and administrative difficulties.

"*The Science Counselor* hopes to help teachers by bringing to them authentic scientific information before it reaches the textbook stage. It will call attention to modern and successful teaching techniques. It hopes to give its readers a progressive point of view; to inspire them to a careful and scientific study of their own problems; to encourage them to analyze and improve the teaching methods they use every day. The staff of this magazine will be glad to help them cooperate in solving their common problems and to assist them in evaluating and applying the results of researches."

We shall endeavor to keep our readers in touch with new trends in science teaching, and to bring them authoritative information about new developments in many special fields of science. We offer to schools the assistance of our staff in selecting textbooks, in improving science libraries, in the planning of programs, and in conducting school clubs, assemblies, and other extracurricular activities.

In turn, we request the cooperation of our readers in suggesting suitable topics and possible authors. We ask them to patronize our advertisers and to support this journal by their subscriptions. Duquesne University has always absorbed without complaint the yearly deficit resulting from the maintenance of *The Science Counselor*. Those who benefit by the University's "good work" should show their appreciation in a substantial manner.

H. C. M.

A FAMOUS LANDMARK

THE HISTORIC CHURCH OF ST. PETER
BROWNSVILLE, PA.

The U.S. Office of Education Serves Science Teachers

• **By John W. Studebaker**
COMMISSIONER OF EDUCATION, WASHINGTON, D. C.

In this article the United States Commissioner of Education tells of plans to help improve the teaching of science in the United States.

Science teaching involves many troublesome problems of planning, administration, enrollments, course content, equipment, etc. Often such problems can be solved satisfactorily with the aid of experienced advisors. Where can such advisors be found?

The United States Office of Education has recently added to its staff two specialists in science who will consult with and aid public and private school systems and individual faculties by mail, and through personal contacts, in-service training conferences, workshops, and in other ways.

●

The phrase, "we live in an age of science," has long since become trite. It has in no way come to be less significant. It has actually come to take on new meanings and to receive more and more thoughtful recognition in educational planning.

Our children, at a very early age, manifest many interests in the world in which they have their being. They enter our schools, curious about the things and forces which surround them. They very early encounter problems about animals, plants, sound, electricity, and other phases of physical and biological phenomena.

How schools can best guide and direct learning in the field of science, is one of the many problems confronting educators. A survey of the teaching methods, courses of study, and other similar evidence related to science teaching, indicates that, although much progress has been made, there are still many problems unsolved.

The program in the elementary school is as yet comparatively untouched when measured in terms of well-thought-out programs. The teaching in a large percentage of the schools is still incidental. The teachers in the elementary school are generally lacking in much of the necessary background in science subject matter as well as in methods of teaching science. Although some schools have developed well-organized courses in grade school science, there still remain a much larger number of schools in which science has received but meager emphasis. Much work remains to be done by the schools in the development of courses of study which are functional in that they assist pupils to solve the problems which they find in their environment, to broaden their interests, and to begin the development of scientific attitudes.

Science instruction in the junior high school grades is commonly included as a definite part of the school program. Many schools have developed excellent programs of instruction. However, much general science still consists largely of reading books, discussing questions based on such readings, and performing in a more or less perfunctory manner some of the described experiments. Growth in the ability to understand and use the scientific method and to sense the significance of scientific attitudes through applying them in the solution of problems which are real to the pupils is still too commonly overlooked in attempts to cover a list of topics. This is unfortunate since general science is perhaps the most important science course because pupils study it at an impressionable age and because this is often the only science course studied by our youth.

Much senior high school science teaching continues to be definitely worthwhile to the students enrolled. Evidence of need for improvement in the science program is reflected in such conditions as: *(a)* inadequate, inappropriate and ill-used facilities and equipment; *(b)* enrollment in the sciences, which should be expanding rapidly, continuing at best to hold its own while in many places it is actually dropping; *(c)* the introduction of a variety of new science courses and, *(d)* the eagerness of educational leaders to secure expert science consultants for their curricular planning. There appears to be a need for school faculties to study the place of science instruction in the education of high school youth and to develop courses of study and other curricular materials designed to meet the varied present day needs. There is also a serious need for the faculties of our colleges and universities to give thought to the development of their programs for the training of science teachers in order to make available teachers who are prepared to meet the challenge of the extensive and intensive interests of our youth.

The problems of science teaching are even greater than the preceding paragraphs would indicate. In only a comparatively few instances has serious thought been given to science as a part of a twelve-year program—each year building on and expanding the previous instruction to insure a well-balanced series of science experiences throughout a pupil's school attendance. When this is coupled with the problems of correlations and integrations with other school offerings, we begin

to sense the full scope of the problems which now face us because so little guidance and help has been generally available to educational leaders and classroom science teachers.

With these problems in mind, the United States Office of Education has, as part of its program to improve its services, appointed two new members to its staff. Glenn O. Blough has come into the Office to serve as Specialist for Science in the Division of Elementary Education. He will work in the field of grade school science. Philip G. Johnson is now serving as Specialist for Science in the Division of Secondary Education. He will work at the junior and senior high school levels. The services of these two former classroom teachers of science are available to the schools of the United States for the primary purpose of assisting them in the improvement of instruction in the sciences.

It is anticipated that the services of these Specialists will be both extensive and varied. Many state groups, county school units, city school systems, and private school faculties are at work on courses of study or other materials which, it is hoped, may improve science teaching at one or more levels of the twelve grades. The U. S. Office of Education, through these two Specialists, is now equipped to render some specific service to such groups. As far as their time permits, their services will be available through personal conferences or by mail when personal attendance is impossible. Through contact with curriculum-making committees in various parts of the country, they will be able to disseminate some of the observed practices, and to indicate where further study may be needed. Certain bibliographies and bulletins relating to science education will be prepared as rapidly as possible, and distributed by the U. S. Office of Education for the use of officials and teachers who desire such help. The services of the Specialists are available for occasional workshop groups of teachers, for in-service training conferences, and for discussions with various individuals interested in furthering the teaching of science. Plans are now under way for the Specialists to be in close touch with the science curriculum work in progress in various State Departments of Education.

We are all aware of the importance of improving the teaching of science in the United States. We are aware, too, of the efforts which superintendents, supervisors, teacher groups, and others are expending in this direction. The United States Office of Education can now be of help in this important aspect of educational development. The services of the Specialists for Science, of course, will be advisory and stimulative, but never directive. In this type of service they will help the progress of education for the new generations which will assume the responsibilities for directing the affairs of our Nation.

The Specialists

Mr. Glenn O. Blough attended Central Michigan College of Education, Mount Pleasant, Mich., from which he was graduated in 1924 with a life certificate to teach. He received his A. B. degree from the University of Michigan in 1929 and his A. M. from the same institution in 1932. His educational experience began in the public schools of Mount Clemens, Mich., in 1929, where he taught science in the junior high school until 1931. From 1932 until 1936 he supervised student teaching in science, conducted extension courses in science content, and developed courses of study for grades and junior high school at the State Teachers College, Ypsilanti, Mich. He was assistant professor of science at the State College of Education, Greeley, Colo., from 1937 to 1938, following which he became instructor and supervisor of science in the laboratory school of the University of Chicago, where he remained until 1942. Entering the Navy in 1942 with the rank of lieutenant commander, he was assigned to the supervision of instruction in Navy schools.

Mr. Blough is the author of "Basic Science Education Series," comprising 12 elementary science books; 20 units of an "Instructor Series of Illustrated Units"; a book, "Science in Elementary Schools"; a monthly counselor service, "Your Science Question Box"; and a book of juvenile fiction. He is co-author of a series of elementary science books, "Discovering Our World"; and "A Program For Science Teaching in the Elementary and High Schools." He has contributed science material to Encyclopaedia Britannica Jr., and World Book, as well as numerous articles to national magazines. He is a member of Phi Delta Kappa and Phi Sigma. His new duties with the Office of Education began on March 25, 1946.

Dr. Philip J. Johnson received his B. S. degree from the University of Nebraska in 1923, his M. A. degree from the same institution in 1931, and his Ph. D. from Cornell University in 1933. He began his teaching career in the Havelock, Neb., high school in 1923. Two years later he became supervisor of science instruction, University of Nebraska High School. In 1935 he became assistant professor and supervisor of teacher training in science at Cornell University, adding in 1935 new responsibility as director of teacher training in science in the Ithaca, N. Y., public schools.

Dr. Johnson is author of numerous science publications, including among others: "The Sciences Need the Social Studies," "Socializing the General Sciences," and "A Critique for the Evaluation and Development of Science Courses of Study for the Pre-College Years." He is president of the National Science Teachers Association, and member of the American Association for the Advancement of Science, The National Education Association, the Association for Research in Science Teaching, and the N. Y. State Science Teachers Association. ●

The Atomic Bomb and World Peace

• **By Robert J. Maurer, Ph.D.** *(University of Rochester)*
DEPARTMENT OF PHYSICS, CARNEGIE INSTITUTE OF TECHNOLOGY, PITTSBURGH, PA.

This thoughtful paper will help teachers of science form a reasoned judgment on a matter of vital and immediate concern to all the world.

The America which developed the atomic bomb is especially vulnerable to its use. But when the control of atomic energy is concerned, Americans must learn to think, not nationally, but internationally. The bomb causes destruction on such a monstrous scale that retaliation by the victim may be impossible or futile. Some reasonably safe method must be devised for controlling or preventing the manufacture and use of the bomb by an unscrupulous aggressor.

Here Dr. Maurer discusses some of the plans for control now under consideration.

●

The development of the atomic bomb has created a threat of unprecedented magnitude to the security of the United States and to world peace. It is the primary purpose of this discussion to indicate how the unique character of the weapon is responsible for this situation. Clearly, a correct understanding of the problem is a prerequisite for its solution. In this case the cost of failure is havoc and destruction upon a scale so vast as to well merit the name of world suicide.

The most important single characteristic of the atomic bomb is the magnitude of the destructive power contained within its modest dimensions. We know that a plane can carry a bomb such as that used against the Japanese and that the explosive charge weighs less than two hundred pounds. Assuming that the charge is uranium 235, it is possible to calculate its dimensions since the density of uranium is well known. Two hundred pounds of uranium occupies a sphere whose diameter is less than nine inches. This is the charge which is the equivalent of twenty thousand tons of TNT; which is capable of destroying four square miles of a city and causing the deaths of tens of thousands of people.

The small size and destructive power of the atomic bomb make possible an enormous decrease in the effort and cost necessary for the reduction of an enemy objective. This fact is well illustrated by the following example. During World War II the Allied Nations dropped approximately one million tons of explosives upon Germany. To accomplish this task one million planes were flown over Germany during a three year period. The equivalent weight of explosive in the form of atomic bombs could have been delivered to the target by fewer than one hundred planes in the course of a single night. A similar atomic bomb raid upon the United States could result in the loss of fifty per cent of our population and eighty per cent of our industrial facilities.

It is pertinent to inquire whether there may not be an effective defense against such an attack. The scientists responsible for the development of the bomb warn us that there is no specific defense against the bomb itself—only defenses against the carrier of it. The record of conventional anti-aircraft and fighter plane defenses against bombers during the last war is a testimony to their woeful ineffectiveness. It is of no avail to prevent twenty percent of the attacking planes from reaching their target if the cargo of a single plane will destroy it.

The scientists of the Radiation Laboratory of the Massachusetts Institute of Technology, who were largely responsible for the development of radar, have publicly stated that novel and spectacularly effective defenses which utilize radar techniques must not be expected. Against the long range rocket traveling at supersonic speeds no worth while defense is anticipated. Not one German V-2 rocket was intercepted.

To this grim picture must be added another very real threat—the mining of our cities in time of peace by a potential enemy. We have a long, unprotected seacoast and land boundary. The size of atomic bombs makes it completely feasible to smuggle them into our cities to be detonated at will. Such bombs would be extremely difficult to detect and remove. We could never be certain that our cities were free of them and they could be used as a potent threat to induce submission to aggression.

It is probably true that at the present time the United States is the one nation to possess atomic bombs. But it is the considered opinion of the nuclear scientists and engineers that other nations, such as Britain, France, and Russia, possess the scientific ability, the industrial facilities, and the materials to duplicate our achievement within two to fifteen years. The threat to our security is one which we, not our children, must face.

Two conclusions may be drawn from the preceding discussion. The first is that the atomic bomb makes possible destruction upon an intolerable scale. If an analogy may be permitted, the nations of the world may be likened to a group of unruly children whose conduct has been tolerated in the past because of their limited ability to harm each other. In fact, there have been individuals who extolled their behavior as a

source of strength and as indicative of healthy growth. With the advent of the atomic bomb, pistols have been placed in the hands of the children and fatal accidents may confidently be expected.

Another conclusion to be drawn is that the atomic bomb gives an overwhelming advantage to the aggressor. Retaliation by the victim of an atomic bomb attack may be impossible or futile. This circumstance makes the atomic bomb a potent source of war. Unless methods are found which make it possible for the nations of the world to insure their safety by other than the conventional and now inadequate means of defense, they will turn to aggression as their one slim chance for survival.

International control of atomic energy has been widely advocated as a means of preventing the destructive use of atomic bombs. Such control is technically feasible as long as a few rather uncommon substances such as uranium and thorium are the sole practical sources of atomic power. In a technical sense, it is a practical matter for an international authority to have jurisdiction over the mining of ores from which fissionable materials may be extracted; and to have complete control over the allocation and use of the final products. The nuclear scientists feel that any satisfactory control system must also provide for the free exchange of scientific information in order that each nation may be fully aware of scientific developments in other nations.

Difficulties which may well prove insuperable arise when one attempts to satisfy what may be called the political conditions for satisfactory international control. It is necessary that every nation which has it in its power to manufacture atomic bombs be a member of the control system. The refusal of one of the major powers to cooperate makes the operation of the system futile. Furthermore, it is absolutely necessary that each member nation be satisfied that compliance with the terms of the agreement does not place it at the mercy of an unscrupulous neighbor. Since the consequence of a successful evasion of the control system may be the complete destruction of a nation or nations, the guarantees of safety must be secured in a manner never before contemplated in international affairs.

If the international authority is to be able to reassure the nations of the world concerning their safety it appears that it must possess inspection committees, composed of delegates from each nation, which must have access to any area, any structure, any individual in any part of the world. It will no longer be possible for the United States to claim that what occurs within her territorial limits is not the concern of the other nations of the world nor for Russia to conceal her internal activities. The sovereign powers of individual nations must be sharply limited.

The extent to which the sovereignty of nations must be curtailed is clearly seen when one reflects that a successful control system which limits itself to the features which have been described merely insures that atomic bombs do not exist at any time. If an aggrieved nation leaves the system, there will be a wild race to build the first bombs and the control system will have delayed but not prevented the final catastrophe. Such a system is intrinsically unsatisfactory since even during the period of its successful operation the nations whose industrial and scientific facilities are inferior will not be free from fear. It appears that secession from the system cannot be permitted, and that the international authority must possess military power sufficient to prevent such an event.

The manifest reluctance of the great nations of the world to yield their ability to make war and to intrust their safety to a world state must not be lightly condemned. Not merely as individuals but also as nations do we echo the words of Patrick Henry. The nations of the world will certainly prefer death by the atomic bomb rather than any system which robs them of their legitimate liberties. The fundamental problem of the present world crisis is that of erecting a system of international cooperation sufficiently powerful to prevent any nation from using the atomic bomb against its neighbors and yet so nicely balanced as to eliminate the possibility of a nation gaining world supremacy by more insidious methods.

It is clear that the United Nations as at present constituted does not restrict the sovereignty of the major powers to the degree necessary for satisfactory control of the atomic bomb. But, no member nation can be allowed to delay the formation by that body of an interim system of control. At present the world is in a metastable condition because one nation, and a peace-loving nation, possesses the atomic bomb. This state of uneasy stability will automatically vanish when more than one nation possesses atomic bombs. We must have international control before that time arrives.

Since the prospects for satisfactory international control are by no means bright and since we are already in the midst of a feverish race in which Britain, France, and Russia are attempting to duplicate our achievements, it is well to contemplate the pattern of the future if cooperation proves unsuccessful. We will be forced to a vast expenditure in order to decentralize our cities and afford a modicum of protection to our people. We will be forced to accept an army of federal spies who will invade our homes and our privacy in order to lessen the danger of sabotage by atomic bombs. Our government will have to be so constituted as to be able to wage instant war upon an aggressor. We will have to contemplate the waging of an aggressive war as a sanitary measure. Our security, our liberty, our pride as a peace-loving nation will have been sacrificed for the dubious privilege of engaging in suicidal combat.

(Continued on Page 61)

Science Projects — Why and How

• **By Sister M. Augustine, I.H.M., B.A.** *(Marywood College)*
ST. ROSALIA SCHOOL, PITTSBURGH, PA.

Competition stimulates students. Properly controlled, it makes for good scholarship. Winning prizes when there are many strong competitors arouses school spirit.

Here is a brief account of the repeated successes of a biology teacher and her classes in winning prizes for their personal and group projects at the Buhl Planetarium School Science Fair, undoubtedly the largest and most elaborate affair of its kind.

Neither money nor expensive or unusual apparatus was involved in any of the prize winning projects. Only good planning, enthusiasm and work were required.

●

Among our tasks as science teachers, we are told, is to discover and develop science talent in the youth of America—to ferret out potential Curies, Pasteurs, and Flemings; to train and guide these embryonic geniuses so as to provide for our country a continued future of scientific discovery and research comparable to that attained during the past war.

Our government authorities, our educational institutions, our civic organizations, all unite in demanding that a program of science education and scientific training be given its proper place in American culture. They are willing to share the responsibility of inaugurating such a program.

The proper role of the government was pointed out by President Truman in his address to Congress, September 6, 1945, when he stated: "No government adequately meets its responsibilities unless it generously and intelligently supports and encourages the work of science in the university, industry, and in its own laboratories." Our institutions of higher learning have cooperated by establishing scholarships and fellowships for the scientific and technical training of promising young men and women. The annual Science Talent Search to discover students with exceptional aptitude; science quiz programs offering college scholarships as awards; and School Science Fairs in which the original creations of budding scientists are exhibited, these and similar activities sponsored by our civic organizations indicate that they, too, try to do their share in developing the scientists and technicians necessary for the security of our national life. To this last activity, the sponsoring of science exhibits as a means of discovering and fostering scientific ability, this article is devoted.

My experience as a science project sponsor dates back a little less than three years to my first year as an instructor in a Pittsburgh school. The usual notice of the opening of the Junior Science Fair was delivered to me. I announced it to the young ladies of my science groups—ours is strictly a girls' high school—and then mentally pigeon-holed the affair until I should become better acquainted with Pittsburgh, and Pittsburgh science fairs. However, I was soon besieged with requests from my pupils to permit them to enter a project in the Fair.

At that time we were mounting mammal parts as a laboratory exercise. I suggested that we elaborate the project and use it as a Fair exhibit. The girls worked in groups of two. One group obtained a sheep's head at a slaughter house. Another group frequented fish markets until they located a specimen with perfect fins. Two others, nurses-aides in a hospital, prevailed on a doctor to secure a guinea-pig for them. Another, whose father had been hunting, brought in the legs of a deer. Other pupils secured a pig's head, donated to the cause of science by the family butcher; a pair of pigeons, reluctantly parted with by the neighborhood pigeon-fancier; and last, but best of all, an immense tom-cat, already slated for the S.P.C.A.

Directions for defleshing and articulating the bones, as well as for tanning and dyeing the cat's skin, were obtained at the Carnegie Library. Of course "Tom" and the little guinea-pig had paid a visit to the laboratory gas chamber before we reached this stage of the work. We made several trips to the Carnegie Museum, where Dr. Doutt, the head mammologist, graciously conducted

MISS RUTHADELE CUNNIFF, a 1946 prize winner in the senior biological section

us through his department, showing us in detail how skeletons are wired and how raw skins are tanned. He even took us to the osteology workshop, where an immense fossil, which had been unearthed in one of our western plains, was being mounted.

The girls were enthusiastic, though we met with some discouraging disappointments. How well I recall the pigeon's vertebrae that just wouldn't look natural, the fins that wouldn't stay on, and the conglomeration of bones that had been our precious guinea-pig! Through it all, however, there was never a thought of giving up, but always the perseverence, the stick-to-it-iveness of real scientists.

An artistic background was planned, giving "Tom" the prominence due him, some snapshots of the girls actually doing the work were added, and with our specimens mounted, we were ready for the Fair. There were 263 exhibits in the 1944 Fair. We appreciated the excellent workmanship of most of them, and realized there would be keen competition. We had little hope of taking a prize. You can imagine our amazement and joy, then, on seeing the picture of our project in the "Pittsburgh Press" the following Sunday, with the announcement that it had been awarded first prize.

School had scarcely begun the following September before I was plied with requests from would-be exhibitors. The fact that no time except the weekly laboratory period could be devoted to the project failed to lessen their enthusiasm. The actual work on the project was postponed until the second semester. It was agreed to devote every evening from 3:30 until 6:00 and all day Saturday to the work, for one month previous to the Fair.

We planned to exhibit a comparative study of the vertebrate animals as our project. Preserved animals were procured from one of the laboratory supply houses, and with nothing but textbook illustrations to guide them, the girls began work. Perhaps cutting through the skull of an animal with a bone scissors for the first time and uncovering a perfectly formed brain doesn't seem thrilling to you, but I'm sure Marie Curie's exultation at the discovery of radium was no greater than the delight of the little girl who on that first afternoon removed the brain of a fish and brought it to me on a glass slide, with the exclamation: "I have it! It's just like the picture in the book!" Heretofore she had been an indifferent science student. Now she is an avowed scientist, with nothing less than medical surgery as her goal.

For this exhibit we selected a type animal from each of the five classes of vertebrates and made a comparison of the heart and brain structures, as well as of the skull, and fore and hind appendages. The actual organs were displayed, together with labeled sketches of each. Again, too, we used photographs of the girls doing the work.

A Prize Winning Exhibit
Left, ANN PHILLIPP Right, LITITIA MCAULIFF

Our second success made the School Science Fair increasingly popular, and our selection of exhibitors increasingly difficult. Since there was neither time nor material for all who wished to take part, I had to resort to an elimination process. My first field assignment in the Fall is usually the making of individual insect collections, for which I allow a period of six weeks. This year when making the assignment I announced that the three who procured the best individual collections would be permitted to combine theirs, enlarge it, and enter it as a Science Fair exhibit. The announcement had the desired effect. There was keen rivalry, and the results were far better than in any previous collection. Laboratory sessions during the collection period were spent in the construction of insect-killing jars, butterfly nets, drying boards, etc. We knew it would be impossible to include all the orders of insects in our display, so we decided to exhibit only the eight more common ones.

In classifying the combined collection, each girl selected one order and concentrated on that until the box was complete, and then began work on another. Volume after volume of entomology was studied. Every marking and distinguishing characteristic was carefully scrutinized with a hand lens in order to classify correctly each specimen and note properly its genus and species. It was amazing to see how quickly the girls became familiar with the Latin nomenclature, and how freely and intelligently they discussed the peculiarities of the different orders and families. To check on the accuracy of our work, we examined the private collections of several insect hobbyists, as well as the elaborate display at the Museum. Mr. Fricke, of the entomology department at the Museum, kindly permitted us to examine some of his work. He was most helpful in pointing out the distinguishing differences in some of the more closely related species. Our project turned out to be not only a prize-winning exhibit, but a serviceable classroom model for the teaching of that phase of biology.

(Continued on Page 62)

Stream Pollution and Soil Conservation

• **By Francis Chilson, D.Sc.** *(Duquesne University)*
INDUSTRIAL CONSULTANT, NEW YORK CITY

It is a national disgrace that so many beautiful American rivers are really carriers of highly diluted sewage. And these polluted streams furnish drinking water to down-stream communities.

This is esthetically shocking. It is a grave danger to public health. And it also represents an economic loss of staggering amount.

Dr. Chilson here discusses briefly some of the factors involved in this question of universal concern.

●

To my mind it is immoral and criminal that people should be forced to drink polluted water, regardless of how adequately it has been treated beforehand.

That it is downright dangerous there can be no doubt, because the U. S. Public Health Service will tell you a water source which contains more than 100,000 coli to the pint cannot be made safe for drinking purposes. Even the most modern and effective large scale purifying treatment now known does not remove all the disease organisms from it.

In spite of this established fact the sewage of half the population of this country is dumped into waterways which serve as the source of drinking water for millions of persons. Remember, too, that in the recent survey of the Ohio River Basin made by the U. S. Public Health Service, the coli count ran as high as 405,000 to the pint at Emsworth Dam, six miles below the City of Pittsburgh, Pennsylvania. At 740 locations out of two thousand visited along the Ohio and nineteen of its tributaries, the coli counts of samples were high enough to make the water supply "unfit" either for drinking or bathing. Traceable to swimming or boating at a portion of 1,160 locations were recurring cases of typhoid and other intestinal diseases. Samples from all of these waters showed the source to be of "questionable quality" for drinking purposes and unfit for bathing.

From a series of carefully controlled experiments on human guinea pigs, two Philadelphia physicians reported evidence that infectious hepatitis (jaundice) is carried by contaminated drinking water. Their studies were made at the University of Pennsylvania for the Preventive Medicine Service, Office of the U. S. Surgeon General. But while medical research has also now established that the poliomyelitis virus has been isolated from water containing raw sewage; while deaths from diarrhea and enteritis, and periodic outbreaks of "intestinal flu" are and have been traced to waterway pollution we continue on our merry way, cheerfully nourishing the grim reaper for want of a little Congressional action.

Long before the end of the war was in sight I proposed to the Federal government that the problem of stream pollution be approached for what it is, a national problem. I outlined a practical program of action. No less than six bills providing for the abatement of waterways pollution have been placed before the Congress. Of these, the Barkley-Spence Bill is favored by the Conference of State Health Officers and approved by the U. S. Public Health Service. This piece of legislation proposes that the Federal government extend to communities "grants in aid" provided that equal amounts be expended by the communities. For industries it would provide loans, to a total of one billion dollars, to be spread over a ten year period. All loans would be required to be repaid in full.

As this is written I am informed from Washington that "no Congressional action has as yet been taken on any national stream pollution measures". Several bills are pending in the Rivers and Harbors Committee, and consideration by executive session of the Committee should be in progress when you read this.

It is my conviction that Congressional action should be more inclusive than the provisions of the Barkley-Spence Bill. We must recognize that some communities simply are unable to finance their share of participation in a pattern of sewer lines and sewage treatment plants. As a consequence, if there is one non-participating up-stream community in an area the raw sewage would go pouring downstream to the complete disruption of the program. Of course, on the basis of finance there would be not one but many. Federal aid and action should therefore be on the basis of established need. Nor would this be unfair to those communities whose tax structure and bonding powers would enable them to share in the cost. They would benefit to the same and greater extent than they benefit from national highways which must be as good in Straw Pump Corners as in Boston if they would serve the transcontinental motorist.

From the taxpayer's standpoint it is interesting to observe that a national sewage recovery project would represent a gain in the national economy of incalculable value, if not actually a self-sustaining and self-liquidating investment. The annual expense to the people for a project costing $1,600,000,000 is estimated at slightly in excess of $100,000,000 yearly. This is less than the most conservative estimate of tangible damage from pollution in a like period. And it must be remem-

bered that damages can be tangible even though not direct and have been so determined at actual cash values by the courts. The estimated yearly cost given above would include interest, sewer and treatment plant costs, depreciation, maintenance and operation.

We must not overlook the profit-making possibilities of a sewage recovery plant, which although not sufficient to pay more than a portion of the plant operating costs, is an added reason for abatement of pollution. The American cities which pioneered the work afford their taxpayers a cash saving and give the land greater productivity. Milwaukee, for example, operates a sewage recovery plant in which the dehydrated solid matter recovered from sewage is granulated and sold under the trade name, "Milorganite" at $40 per ton, wholesale. This is an organic fertilizer, completely odorless and very high in nitrogen. Many of the country's finest golf courses are maintained in a green and thriving condition with this material. The City of Toledo, Ohio, produces "Tolegro"; Grand Rapids, Michigan, markets both "Grandgro" and "Rapidgro".

Better fertilizing materials are needed and the need is growing. It is now said that the depletion of the soil has reached the point where our food will lack, increasingly, the nutritive elements it should properly contain. Commercial fertilizers will not fill the bill, and in the long run they are not good for the soil, because they destroy the earth worm population and also destroy the porosity of the soil which depends so much on humus.

Every intelligent American knows—or should know—that the rich topsoil of this country is rapidly disappearing. Estimates prepared by the Department of Agriculture show that 40 percent of all our top soil already has been destroyed by bad farming practices and the lack of organic fertilizer. Yet, we complacently ignore the fact that from every city, town and village in the United States, millions of tons of sewage annually pour into the ocean along with our rapidly disappearing top soil.

Right now, for the first time in our history, we are confronted with a serious shortage of food of all kinds. The food shortage has not been caused entirely by the war. Experts of the Department of Agriculture have shown that the United States has never produced more than a three months' carry-over of general foodstuffs, such as meat, vegetables and dairy products. Unfortunately we think of food production in terms of grain, and whenever we have a bumper grain crop everyone assumes that the wolf is far from the door. The fact is we never have had a surplus of other than grain foods because of the decreasing fertility of the land and the disappearance of our top soil.

As a consequence of our failure to supply the land with sufficient organic manure and fertilizer, our food production per capita has been steadily declining for 20 years. In the last 75 years tremendous improvements have been made in the science of crop production. Yet, today, one of the most important measurements of the decline in soil productivity is expressed in terms of crop yield. It should therefore be of more than passing interest to note that although the population of the country has increased more than 30 per cent in the last 40 years, our production of general foodstuffs has increased only seven per cent.

There has been no lack of effort to keep food production on a par with the population. Chemical fertilizers have been developed and applied in greatly increased amounts; agronomists have devised better crop rotation and improved farm management, and both plants and seeds have been adapted to varying conditions of climate and soil. But the result has not been a Horatio Alger denouement. Crop yields *have not* increased in accordance with scientific progress.

There is no mystery about the disappointing situation just cited. In providing farmers with modern equipment we have given them the means with which to rip up more soil in a shorter time than was possible when draft animals were used. Draft animals produced much of the manure with which the fertility of the soil could be sustained, but gasoline driven engines have not yet been made to produce manure and are not likely to be.

If any further evidence of the inadequacy of chemical fertilizers is needed, the 1940 Yearbook of the U. S. Department of Agriculture clinches the case by citing that in Ohio the average yields of corn per acre for the State were about the same for the decade 1920-29 as they were in the decade 1870-79. "Yet" and I am quoting H. H. Bennett, Chief of the Soil Conservation Service, "the average use of fertilizer per acre on Ohio farms increased 340 percent from 1870 to 1929".

Other illustrations could be offered, emphasizing the point over and over, that the steady depletion of soil fertility has almost generally offset advances in the science of agricultural production, while at the same time farm production costs have increased greatly. It is also a matter of record that the tremendous use of artificial fertilizer in the past 50 years accounts for a large part of this increased cost. So serious has the problem become that hundreds of thousands of farmers have been forced below the margin of profitable operation, and as a consequence abandon the land.

Hence, it can be seen that the salvage of sewage is directly connected with our soil conservation program.

(Continued on Page 62)

Marine Research

A Field for Graduate Training

• **By Mary Frances Walter.** *Cincinnati, Ohio*

Important researches in the plant and animal life of the sea are being conducted under the direction of Dr. George Speri Sperti at the Marine Biological Laboratory of the Institutum Divi Thomae, located at Palm Beach, Florida.

This is a story about beautiful Bradley Hall and those who work and study there. It relates how research problems present themselves or are sought, and how solutions of the problems are planned and carried out.

●

"Out of Carnage" by Alexander R. Griffin, a fascinating book about the battle against death in war, states "the most dramatic development in burn therapy was enacted in a Cincinnati laboratory" . . . then it named the discoverer of the new healing agent, Dr. George Speri Sperti, and described his work in biodynes.

The "Cincinnati laboratory" mentioned in the book is the Institutum Divi Thomae, at Cincinnati, an Archdiocesan graduate school of science and research, the work of which has been recognized and published by many scientific journals.

The Institutum Divi Thomae technical staff follows many avenues of research and supports widespread research units throughout the country. Perhaps to one who has a deep interest in biology, the companion marine biology laboratory at Bradley Hall, Palm Beach, Florida, has a particular fascination. I was interested to learn what place the marine research occupied in the over-all program of the Institutum.

Dr. George Speri Sperti, scientist and member of the internationally famous Pontifical Academy of Sciences, was sitting in the study of his "University of Science", the Institutum Divi Thomae, when I arrived. His secretary ushered me into the study, and after introductory formalities we launched into a discussion which was prompted by a book the scientist happened to have before him.

Dr. Sperti explained that the book entitled "An Introduction to the Marine Invertebrates" had been written by Professor John C. Fardon, one of the research professors of the Institutum, while engaged in marine biological work at Bradley Hall.

I was happy that Dr. Sperti's mind was focused for the moment on the marine subject. My questions regarding the marine work, therefore, were quite appropriate and his answers produced a number of thought-provoking ideas. I learned that the marine laboratories were established for two reasons: firstly, to extend research in cancer, because the cancer problem is fundamentally one in biology, and the marine work provides another source of biological material for experimentation; and secondly, to use these facilities to round out and develop the post-graduate student in biology by providing a variety of live marine animals with which to work.

Dr. Sperti believes that a graduate student obtains a more complete understanding of marine zoology and botany when he or she has practical first-hand experience with marine studies.

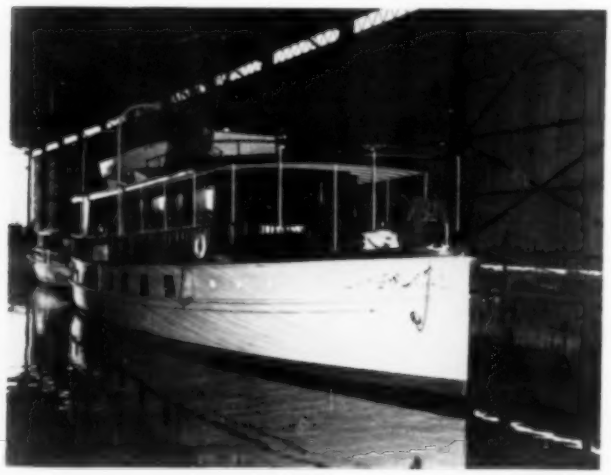
When you consider the very elementary fact that three-fourths of the earth's surface is covered by water, and when you consider the teeming life in myriads of forms in the sea, then you begin to appreciate the important part marine life plays in this world of ours.

THE PATIO OF BRADLEY HALL
Here the final analysis of drugs is made under ideal conditions. Students work directly with professors in open air classrooms

Biology can become a humdrum subject under the stifling routine of the classroom—but once the classroom extends to the ocean floor it can become the most glamorous and stimulating subject in the curriculum.

Dr. Sperti said that research consists of prodding into the unknown, and one of the first qualifications of a good scientist is "imaginative curiosity."

It is obvious that the quality of imagination can not be developed very far in the staid classroom. It takes environment for the stimulation of the student, and that is one of the reasons for establishing Bradley Hall near the sea. Dr. Sperti and his staff require all Institutum biology students to study part time at the marine biological laboratories in actual contact with the natural habitat of the citizens of the sea. This is also the reason the floating laboratory research ship Aquina was equipped to carry students into bays and inlets and far out to sea to study, first-hand, the great wonders of the ocean.



Research Ship Aquina attached to the Marine Research Laboratory

"Ideas come from fertile imaginations," said Dr. Sperti, "and fertilization of the imagination comes from contact and experience—and from hundreds of picture images recorded on the mind." "For example," he continued, "I happen to be looking at the section of Professor Fardon's book dealing with star-fish. If my particular interest in biochemistry is growth-factors, I would be fascinated to learn why and how a star-fish can regenerate an entirely new arm, once an arm is severed, and this knowledge might prove of fundamental importance in the cancer problem which is one of cell growth."

It is indeed regrettable that most students in biology do not have the opportunity to see the strange weird life of the marine microcosmos. An ordinary conch shell becomes under the microscope a world teeming with fascinating forms of life. When one first sees this strange new world revealed under the low-powered binocular miscroscope it is almost frightening. Then watch the antics of the hermit crab, the sand flea, the sea cucumber, the sea urchin, and hundreds of other amazing specimens and soon you'll forget you are actually studying these creatures, and suddenly, learning becomes an all-absorbing hobby.

When a student enters the marine laboratories, and goes down to the sea, as he looks over the vast expanse of water he is impressed with the fact that, as a student in biology, the sea is really his laboratory which offers oceans of opportunities in exploration.

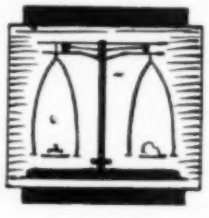
"We are planning to bring more post-graduate students in biology and related fields to Bradley Hall," said Dr. Sperti. "Perhaps we can arrange special short courses in marine zoology and marine botany to provide, even if only in a limited way, actual contact with marine subject matter."

Monsignor Cletus A. Miller, President of the Institutum Divi Thomae, emphasizes the importance on education of a "planned" curriculum in secondary learning and is setting up what might be termed the "educational scout" system whereby promising young high school students are "tagged" for science early in their careers. "Thus," as Monsignor Miller explains, "we shall eliminate deficiencies in students entering for graduate work and obtain only those students genuinely interested in science."

During the war the marine laboratories and the research ship Aquina of the Institutum Divi Thomae, enabled the staff to do important work in producing agar-agar from Florida seaweed. The commercial plant which was constructed is now operating and producing agar-agar by methods developed by the Institutum scientists. The staff and students at Bradley Hall were able to classify, assay, and test hundreds of tropical plants for use in tropical disease experimentation.

However, now that the war is over, the laboratories are reconverted for normal peace-time work, and the subject of cancer assumes its important role as the major subject of research.

Since much knowledge of cell-proliferation and differentiation was first obtained through marine biological research, the Institutum will continue its studies not only at the marine biological laboratories at Bradley Hall, but in all its affiliated units so that it may continue to contribute steadily to the knowledge of cellular activity. ●



How Much are Plants and Animals Alike?

● **By Sister Mary Ellen O'Hanlon, O.P., Ph.D.** *(University of Chicago)*
CHAIRMAN, DEPARTMENT OF BIOLOGY, ROSARY COLLEGE, RIVER FOREST, ILL.

This paper, written by an outstanding scientist, author and teacher, contains much valuable instructional material for the teacher of biology.

It compares and contrasts the most important and significant biological characters that distinguish the higher plants from the higher animals. Nutrition, respiration, growth, and regeneration are considered here.

Part II, which will appear in our September issue, considers grafting, sexual reproduction in plants and animals, embryos and cells.

●

Let us imagine a child on a winter day flattening his nose against the windowpane as he watches a dog chase a cat up a leafless tree. Should we ask this average child to tell the difference between the cat or dog and the tree, the answer might be something like this: "The cat and dog are alive but the tree is not", or perhaps, "Animals can run but the tree cannot."

The first answer, of course, is not really correct; but the leafless tree in the winter condition is certainly in a state of quiescence or dormancy which resembles death. The prolonged sleep of the relatively few hibernating mammals is hardly comparable to the winter condition of the average perennial plant whose roots are frozen in the soil and whose much dehydrated, tightly wrapped buds give little evidence of life.

Most animals are equipped for locomotion. Nevertheless there are some species, including the sponges, corals and other coelenterates, some parasitic worms, barnacles, oysters, and even a few of the lower chordates, which are sessile at least in some of their stages. The typical plant is anchored. Motile organs, however, are found in a few of the very simple plants, and also in the zoospores of a number of the thallophytes. The spermatozoids, too, of many plants, including some of the lower seed plants (the cycads and gingko) also are motile.

The philosopher distinguishes the members of the two great kingdoms of animate things by simply stating that the typical animal is a sentient being; whereas the typical plant is a non-sentient living being.

Some biologists in a discussion of this topic might say that both plants and animals are living things—made up of cells, that is, protoplasmic units, etc.; and that both plants and animals are capable of nutrition and growth and the reproduction of their kinds. For these reasons, the science which treats of them is called biology.

Such a definition however serves only to distinguish animate or living beings from the non-living or inanimate beings. It stresses the resemblances between the two types of living things without implying any of the many real differences which exist between plants and animals.

The serious scientist and especially the well-trained biologist, is fully acquainted with the essential processes which are common to all living things. He knows by experiment and study the various plant and animal organs and the functions which they perform. He is therefore obliged to recognize and to consider the manifold differences in all of the morphological and physiological characters which are exhibited in the various members of the two kingdoms. The differences between any typical plant and any typical animal are much greater than those between two representative organisms of the same kingdom, however much the latter may differ.

It is the purpose of this paper to point out briefly some of the most important and significant biological characters which distinguish the plant from the animal. While the philosopher's distinction is more profound, it may be that it is no more real and universal than many of the distinguishing features of all the organisms which are indubitably classed as plants or animals.

The comparisons and contrasts which we include apply in general to the higher plants and higher animals; that is, to the seed plants and the vertebrates and, more particularly, to the angiosperms and the mammals. These latter are representatives of the highest and more recently evolved groups of the two respective kingdoms.

It is noteworthy that the highest of our four great phyla of the plant kingdom, the seed plants (Spermatophyta) include close to 160,000 species, all but some six or seven hundred of which are angiosperms. These plants with covered seeds represent more than half of the total number of species in the entire plant kingdom. According to zoological computations there are at least 40,000 species in the phylum Chordata, about 38,000 of which are vertebrates. Of the vertebrates, probably not more than 4,000 are mammals. In relation to the total number of animal species (some 8—to 900,000) the number of mammals, the highest and most recently evolved group of animals, is therefore very small. This great discrepancy between the numbers of the highest plants and the highest animals is partly explained by the preponderance of insects in the present fauna—some 5—to 600,000 species. At any rate, the general trend in evolutionary progress is readily seen to be quite different in the two kingdoms.

Nutrition

From the biochemists' point of view, the problem of food manufacture as worked out by the green plant, in contrast with the nutritional habits of an animal, is highly significant.[1]

All living things require food for growth and the release of the energy which is essential to the various other life processes. Foods fall into certain classes of organic compounds the chief of which are carbohydrates, fats, and proteins. For the manufacture of these very necessary life-supporting substances, the green or chlorophyll-bearing plant holds the basic patents. For example, the process of photosynthesis is undoubtedly the most important biochemical process in the whole world; notwithstanding the fact that relatively few of its secrets are known with certainty. To say simply that a sugar ($C_6H_{12}O_6$) is the first known product of photosynthesis is to state a fact as present knowledge has it; but the many possible steps from CO_2 and H_2O to sugar are still an uncharted way. The green plant in the presence of light manufactures sugar as a basic compound and, subsequently, it elaborates fats and proteins in any part of the plant, whether in light or in darkness. Many non-chlorophyllous plants, too, if supplied with sugar and the necessary mineral salts, can manufacture proteins. There is however, no animal which is capable of manufacturing all the basic units of proteins, the amino acids. These, like the carbohydrates, must be supplied to the animal either directly or indirectly by the green plant.[2]

The green leaf, the organ of photosynthesis *par excellence*, is therefore most important to all living things, whether plants or animals or man. Leaves are regularly shed by perennial plants and their dead remains eventually give back to the soil the mineral and organic substances which went into their making. The leaf is consequently a very necessary and conspicuous figure in the whole carbon-nitrogen cycle of life. There is no animal organ which is in any way comparable to the green leaf.

Respiration

The term respiration comes from the verb *spirare*, which literally means "to breathe." The term was evidently chosen to indicate this important biological function before its true chemical and essential nature was understood. Respiration is an oxidation process which is necessary to all living things. Within the living cell, sugar or other oxidizable compounds react with oxygen. The result of this chemical process is a release of heat and energy and a simultaneous discharge of carbon dioxide and water.

In the old-time textbooks, breathing and respiration are identified, breathing being defined as a process which involves an "inspiration" and an "expiration"—the two processes thus being considered "respiration." Of course, this "respiration" is only the external part of the essential process of respiration.

Although all living cells must respire, only animals, and those which include the higher invertebrates and vertebrates, really breathe. This is true because the act of breathing is limited simply to special mechanics for the intake and expulsion of the gases concerned in the essential process of respiration. In animals which have such organs as lungs, the act of breathing is correctly called *external* respiration, or *pulmonary ventilation*.

An analogy may be drawn here in which the pulmonary system of a higher animal is likened to the central office of a rather complicated telephone system. In such a system, it is necessary for the person who wishes to converse by telephone to be connected with and switched through one or more keyboards before he is able to hold the desired conversation. It is plain that all of the preliminary connections only indicate a complexity which is absent in the case of a direct or simple telephone line—a system which is just as efficient so far as the ultimate function is concerned. Any individual cell, whether a part or all of an organism, may be likened in its respiratory functions to the simple, direct telephone system. Plants *do not* breathe, because they have no breathing organs; they receive their oxygen by the simple inflow or by the diffusion of this gas; and the waste gases are discharged in a similar manner. All higher animals, on the contrary, must *breathe* in order to *respire*.

Photosynthesis and respiration are often contrasted, because photosynthesis is the energy-storing process by which inorganic substances (CO_2 and H_2O) are chemically united to form sugar. Incidentally, oxygen is released in the photosynthetic process. Respiration is an energy-releasing process, in which the chemical

(Continued on Page 61)

[1]There are no indubitable animals which bear chlorophyll. There are nevertheless a relatively few, simple, chlorophyll-bearing organisms which are described in both botany and zoology textbooks. The zoologist calls these organisms Flagellata and they include both one-celled and colonial types, such as *Euglena*, *Volvox*, *Pandorina* and *Eudorina*. These organisms resemble the lower animals in certain respects: first, they bear locomotor organs; second, because of some of their reproductive methods; and third, an organelle called a red "eye spot" is present in certain of these cells. Nevertheless, the same types of locomotor organs are found in many plant cells; for example, in the zoospores of certain thallophytes and in the spermatozoids of many plants. In some cells of the thallophytes, too, for example, the zoospores of Oedogonium, the red "eye spot" is also present. There are also a few of the lower animals, which harbor within their bodies certain minute chlorophyll-bearing plants; but in such a symbiotic relationship, the animal partner cannot be said to be chlorophyllous.

[2]Plants take first rank too in the manufacture of vitamins, those organic compounds which are so essential to the normal life of all organisms. Certain bacteria, very small, simple plants, some of which live in the soil and others of which form the nodules on the roots of the leguminous plants, are also basically important. These bacteria are able to synthesize nitrogenous compounds by using the atmospheric nitrogen; and although these nitrogen compounds are necessary to the life of the higher plants, no organism except these special bacteria and possibly some simple algae can manufacture them.

Trailing Prehistoric Man

• **By David W. Rial, M.A.** *(Clark University)*
PRINCIPAL, BRASHEAR PUBLIC SCHOOL, PITTSBURGH

During the summer of 1945, Mr. R. L. Fricke of the Carnegie Museum of Pittsburgh, Dr. Herbert L. Spencer, president of Bucknell University, and his daughter, Nancy, Mr. Ray Austin of Whitehall, Montana, Dr. J. Leroy Kay, and the writer of this article made an archaeological reconnaissance survey into a little known region of southeastern Utah.

This is a brief story of their expedition.

A further account of Mr. Rial's explorations will appear in an early number.

●

Our party assembled late in July at Grand Junction, Colorado. We obtained at Monticello, Utah, the necessary permits for collecting archaeological material, and then proceeded to Blanding, Utah, where food supplies for the expedition were secured and our guide picked up. The town car in which we traveled carried seven passengers and pulled a trailer loaded with five hundred pounds of tents, tarpaulin and camp equipment. It was loaded beyond safety for the passage across the Abajo Mountain which we were about to undertake. In places the road was little better than a trail. It finally became a mere cattle track disappearing into a broken landscape of dry tablelands or mesas, vistas familiar to travelers in the western country.

For the first few miles our expedition led us past communities of somewhat churlish Utes and Navahos living in hogans or tents little removed in their primitiveness from the days of their savage forebears. On our approach to the top of Abajo Mountain we passed through a forest of Ponderosa pines and through scattered patches of scrub oak, juniper and pinion. Fringes of Brigham tea, one source of medicinal ephedrine, reminded us that we were in Mormon land.

Courtesy Carnegie Museum

A Moqui jug.

At nightfall, we made camp at Twin Springs Camp which is maintained by the Scorup Cattle Company. The next day we resumed our journey on horseback. Riding western mounts in western saddles built for utility is a task in itself. Sometimes the trail was too steep even for riding, and the best procedure was to dismount and let our beasts pick their own way. This was regular procedure also in following a dim trail or when one became separated from the other members of the party. By some sense our mounts had an intuitive instinct that was safe to follow, finding the way when the rider was completely lost.

We were now in the Moqui Country, as we chose to call it, a name given by the natives to people who built the houses the ruins of which we were to see, ruins which posed for us many perplexing questions. Were these people agriculturists or hunters? When did they live there? What drove them out? How did they do this or fabricate that, the remains of which we were to find and puzzle over?

Early the next morning, after establishing our permanent camp, we were in the saddle traveling southwest to examine the ruins of some stone structures built upon the flat tablelands. Possibly these stone habitations had originally been towers, the walls of which had been laid up without mortar. Entrance to them obviously was made by ladder. Several ruins seemed to have a paved ramp, stones standing on edge leading up to an end wall of the building. What was the necessity or purpose of such an approach?

About these ruins we found Yuma points and arrowheads of a much later culture, indicating that a succession of cultures had flourished here, that perhaps a later culture had driven out an earlier one. The interior of the buildings was a conglomeration of wind-blown sand, rocks tumbled in from the side walls, and flat stones a foot or more square. The latter, it appeared, may have been used shingle-like for a roof covering. The remains of old fire hearths held charcoal and wood ashes. Samples of the former were taken for reference to competent dendrologists. The ash was treated for alkalinity but none was found, possibly because of leaching over a period of time.

Soon we made our tortuous way from the flat mesa on which our camp was situated to the bottom of the canyons, the floors of which were covered with a light sandstone.

Here single houses had been constructed, none of them high enough inside to permit a man to stand upright. Only rarely did we find more than one house together and these had no connecting inside passages or doorways. The stone walls of these structures were laid up with an adobe clay, the finger prints of the builders still plainly visible. Even the delicate ridges of the fingers were strikingly moulded into the clay, almost as definite as the finger prints used in modern times in personal identification.

Courtesy Carnegie Museum

David W. Rial inspects a Moqui house.

The interior of such houses or caches was usually covered with a dry sandy debris, in depth from a few inches to several feet, some of it the work of pack rats; all, however, had to be sifted if its contents were to be known. At an altitude of seven or eight thousand feet this was a task of no little difficulty. Eager eyes followed each separate shovelful as it fell upon the screen. Some artifact, spear point, piece of flint or pottery or other tell-tale object might be a clew to the nature and form of living of the early inhabitants of the strange buildings.

The area inside was scarcely more than a couple of square yards. What we most anxiously hoped to find were spear points or arrowheads or scraping knives made of flint. One Folsom or Yuma point would have yielded us information of inestimable value from the standpoint of chronology. One such house did yield us bone awls and a fire stick, the latter from the top joint of a corn stalk.

A house which seemed to indicate it may have been a place of more than usual importance, perhaps a council house, had a fire pit some ten inches deep and four or five feet in diameter near it. The perimeter of the pit was lined with flat stones set on edge. It may have been a pit for firing pottery. Incidentally, outside this house was a pile of rubbish, perhaps a sort of garbage dump, on the top of which we found a piece of clay pottery, a jug of beautiful workmanship which was undamaged. The fact that it was lying upside down so that water could not enter to freeze may account for its remaining unimpaired. When it was cleaned with steel wool a beautiful design was found executed on the exterior. In the dry debris near this spot we also found a few grains of corn, a bean and pumpkin seeds with rind. The fact that pumpkin rind, sensitive to decay, was found, gives an impressive idea of the aridity of the climate.

The sifting process yielded sandals of woven yucca. Strings made of that fiber were sifted out; also strings made of bird feathers twisted together in a most intricate manner. A piece of string, if such it might be called, was found made of some root fiber but soft as cotton. The lintels of the doorways where wood had been used for the frames were fastened to the sides by yucca bindings. These fibers were twisted like modern wrapping twine, but also sometimes plaited as one finds children's hair.

Courtesy Carnegie Museum

Pack train on Rim Rock ready to descend into canyon.

Some sites we examined were all but inaccessible, located, we thought, because of ease of defense or for some other protective reason.

Under the overhanging cliff of one such place we found a type of house different from any others. It was built of cedar or pinion pine timber, very roughly laid up, making a miniature log cabin some six feet square. Since the builders lacked adequate tools with which to fabricate the timbers, they were unnotched. Doubtless the only instrument they had for such purposes, to fell trees, to cut them into the desired lengths or for whatever purpose wood working was needed, was early man's greatest friend as well as modern man's greatest enemy —fire.

In that arid climate a five or six inch cross section of such timbers indicated a growth of at least two hundred years.

On the rather smooth shelf under this almost inaccessible cliff which had a depth, in places, of perhaps a hundred feet, we found a pinion pine growing around

(Continued on Page 60)

Predigested Protein Nutrition

● **By Research Staff.** *Wyeth Institute of Applied Biochemistry, Philadelphia*

After many years of neglect, the fundamental importance of predigested proteins in nutrition has now been established. They provide an easy way for the body to obtain its essential amino acids.

This up-to-the-minute article brings together much valuable information. Its timeliness is indicated by the fact that several thousand reprints of this paper will be distributed.

War, with its ravages of the human body—its prisoner-camp fare of watered soup, its concentration-camp diet of slow starvation, and its undernourished homeless victims in all the war-rent nations—has refocused the attention of medical science on protein nutrition after many years of neglect.

The importance of protein nutrition has been realized for a long time, of course, but interest and research lagged in the wake of the excitement over vitamins. Then came the war, and with it a reawakening of interest.

Yet in peace, as well as in war, protein lack among all classes of all ages of both sexes, is not rare. Its victims are not confined to starving populations. Even those who feast on filet mignon, partridge and lobster Newburgh may feel the protein pinch. Serious burns, accidental injuries, shock, serious surgical operations, childbirth, sudden infections and old age may precipitate a protein crisis in the most robust of individuals. Chronic infections, ulcers, allergy, liver, kidney and thyroid disease, cancer, and even psychic causes, swell the ranks of those who may be urgently in need of more protein than they can take in by the normal processes of nutrition.

The production of protein hydrolysates—highly concentrated, predigested proteins—for the treatment of these conditions is a very recent development. Lactamin, manufactured by Wyeth Incorporated, is one of the newest of the protein hydrolysate products to be developed in response to the reawakening of interest on the part of the medical profession to the importance of protein nutrition. It is a free flowing, water-soluble powder made from the lactalbumin of milk—one of the proteins most perfectly supplied with the essential amino acids.

The amino acids are a family of building blocks that come together to form proteins, the proteins in our foods, the proteins in our own flesh. The amino acids are made up of two fundamental factors: the amines, which are first cousins of ammonia and deliver nitrogen to the body's chemical factory; and an acid that combines with the amines.

From twenty-three naturally occurring amino acids, an astronomical number of combinations are formed to make an equally fantastic number of proteins. This accounts for the difference among such protein foods as meat and cheese and strawberries. Some of the "aminos" are made in the body itself. But it may be necessary to supply others ready-made to the body in order to maintain proper human nutrition. That is where hydrolyzed proteins play a vital role.

When, or shortly after, a person sustains an injury, his urinary nitrogen excretion rises rapidly. This indicates an enormously increased breakdown of proteins and amino acids to the waste product, urea. The nitrogen content, both of proteins and amino acids, is about 16 per cent. In the normal course of nutrition, the liver distributes all of the needed amino acids taken from the diet and removes amino groups from the excess which remains. These amino groups are excreted as urea.

The amounts of nitrogen excreted daily in the feces and urine respectively, average 1.3 and 13 grams; most of this is in the form of urea. When the amount of nitrogen so lost equals the amount of nitrogen taken into the body through the diet, the body is said to be in "nitrogen balance". A positive nitrogen balance indicates that more nitrogen is deposited in the blood serum and tissues than is lost (this condition is essential to growth or recovery from a previous nitrogen deficit). A negative nitrogen balance is a danger signal: it indicates that the tissues are being weakened by a loss of their very substance.

One of the functions of protein hydrolysates such as Lactamin is to replenish the proteins of the tissues. In a sense, the blood acts as a protein reservoir. When the level of this reservoir is reduced (hypoproteinemia), it is a sure sign that the tissues have become depleted. When nitrogenous food is supplied under these conditions, the hungry tissues exhaust the protein circulating in the blood so that the level of the protein in the blood is not restored until the tissue hunger has been satisfied.

What probably happens under the disturbed protein conditions cited is that special calls are made on certain particular essential amino acids (methionine in the case of burns), and the sudden dramatic need for one of the essential amino acids then starts the body on a process of self-destruction, or "raiding" of the tissues to secure the needed amino acids.

Although the use of a protein digest is an extremely recent development, its value has been substantiated

in all of the numerous conditions in which nitrogen depletion occurs, such as:

1. Malnutrition: Lack of proteins in the diet is the first consequence of food scarcity. In wars and other crises, proteins, especially the better grades, become scarce long before the calories in the diet reach a dangerously low level. With a limited quantity of food available, the tendency is to raise less cattle and to feed more of the available food to humans. As a result the intake of cereals increases while the consumption of meat and milk decreases. This leads directly to a reduced consumption of essential amino acids.

When the crisis reaches a point where the caloric intake suffers, then a point may be reached where the body no longer benefits from the protein sparing action of the energy foods (fats and carbohydrates).

In World War II, widespread protein deficiency in Great Britain and the United States was avoided by rationing, and by campaigns urging the population to make the fullest possible use of available foodstuffs. In the Hitler-occupied countries, however, millions of men, women and children suffered from advanced protein depletion, resulting in hypoproteinemia to the point of edema and ascites, or leakage of fluids from the circulation into the abdominal cavity.

2. Shock: That a negative nitrogen balance develops after fractures, and that heavy nitrogen losses are part and parcel of every surgical operation in spite of the administration of intravenous glucose, have long been established facts.

Therefore, a high protein intake is essential, not only to combat hypoproteinemia, but also for protecting the liver against injury. Experiments with animals have demonstrated that liver cirrhosis is an ultimate consequence of protein starvation. Fatty infiltration of the liver commonly occurs on a low protein diet, due essentially to shortage of methionine, and fatty livers predispose to more serious hepatic injuries.

3. Burns: Following extensive burns there is considerable skin tissue destruction with continued local loss of serum. Much more serious than the latter, however, is the loss of plasma protein through suddenly increased urinary nitrogen excretion. The extent of urinary nitrogen losses was dramatically demonstrated in the case of 22 badly burned persons who suffered a urinary nitrogen loss of as much as 45 grams in 24 hours, which is equivalent to 280 grams of protein per day.

The requirements for protein under these conditions are so extensive that they cannot be satisfied economically and practically by plasma alone. Some burn cases may lose more than 35 grams of plasma protein per hour shortly after sustaining the injury, and it would require half a liter of plasma per hour to supply this much protein. Obviously it would take a great many blood donors to supply such large quantities of plasma, and the only practical method for continued support of the nitrogen balance is by oral protein ingestion.

4. Food Allergy: Some persons have the misfortune of being allergic to some of nature's best foods, milk, eggs and wheat. While they may sometimes be successfully desensitized, the treatment is necessarily a protracted one. In addition, while the allergist is endeavoring to establish the offending protein, he must arbitrarily limit the patient's diet. This may place a severe strain on the protein intake of the allergy patient. In such cases protein hydrolysates will help maintain the body's protein level.

5. Gastrointestinal Tract: In surgery involving the gastrointestinal tract, the provision of sufficient protein to maintain nitrogen balance is a problem of the first order. Such patients frequently present themselves for surgery with a marked hypoproteinemia and advanced tissue protein depletion due to a combination of insufficient protein intake and impaired digestion or absorption. Ulcers and gall bladder disease interfere with eating, while duodenal ulcers, regional ileitis and colitis interfere with absorption.

Other gastrointestinal conditions which usually involve serious protein depletion are intestinal obstruction, (shock and dehydration), gastric carcinoma and associated febrile conditions.

Cases of peptic ulcer are likely to be accompanied by impaired protein intake and it is even suggested that the converse is also true; namely, that continued protein restriction may precipitate stomach ulcers in the presence of predisposition.

In addition to the nutritional benefit to gastric ulcer patients of protein hydrolysates, their acid binding properties are also notably beneficial. Proteins and amino acids increase the pH of the stomach by combining amphoterically (reversibly) with acids. This beneficial effect is not offset by the so-called "acid rebound" so typical of sodium bicarbonate and similar alkaline medications.

6. Injuries and Surgery: A careful study of postoperative convalescence has shown that recovery time was greatly shortened and strength greatly increased after high protein diets were amplified with oral protein hydrolysates.

In the case of stomach operations for duodenal ulcers and cancer of the stomach, for example, it was found that the slow convalescence and bed periods of 18 to 21 days with loss of weight and weakness were sharply contrasted with the results obtained on high amino acid feeding. In the latter, the bed periods were reduced from 8 to 9 days; there was a gain in weight, and patients were strong on getting up.

7. Kidney Diseases: Bright's disease is a somewhat loose term which has been used to designate any one of a number of kidney diseases, including involvement

of the glomerulae (glomerular nephritis) and degeneration of the tubules (nephrosis).

Hypoproteinemia is an almost invariable occurrence in hemorrhagic nephritis, and improvement in glomerular nephritis is always accompanied by a rise in blood protein.

Especially during the active or "nephrotic" stage of Bright's disease, urinary nitrogen excretion is very high, accompanied by severe tissue wasting. At one time it was customary to restrict protein intake in Bright's disease. More recently, medical men have inclined to the view that protein restriction is necessary only in such cases where kidney function is severely impaired and retention uremia threatened. Nephritics whose protein intake was not limited are generally in better condition than those in whom protein was restricted.

Hypoproteinemia is also an invariable concomitant of nephrosis, the degeneration of the kidney tubules. Daily protein losses are very considerable, being as high as 20 to 30 grams daily in some cases.

Administration of protein digests has been markedly successful in counteracting these serious nitrogen losses. In one instance, a drop in mortality from 60 per cent to 0 per cent in a series of patients over a two-year period was reported.

8. Liver Diseases: Much recent research tends to show that cirrhosis of the liver, as well as other less serious liver conditions, is caused primarily by a deficiency of methionine, one of the essential amino acids.

Cirrhosis of the liver was at one time believed to be due to excessive use of alcohol. It is now believed, however, that alcohol serves only to reduce protein intake, as a result of which the liver is injured. The remedy, of course, is a high protein intake and, in actual cases of alcoholic cirrhosis, forced protein feeding.

9. Pediatrics: Infants and children can absorb and utilize protein hydrolysates. Their use has been recommended in the treatment of hypoproteinemic children who lack appetite, and as dietary supplements for children with kidney and gastrointestinal disorders. Allergy to milk and milk products also may be adequately treated with protein hydrolysates, as pointed out earlier.

10. Pregnancy: The National Research Council's recommended allowances for protein in the latter half of a woman's pregnancy are set at 85 grams per day compared with 60 grams for a moderately active non-pregnant woman. During lactation, the N.R.C. recommends 100 grams of protein per day. Obviously, these figures are intended to cover the needs of the fetus and of the child over and above the normal requirements of the mother. Many physicians incline to even higher protein intakes for pregnant and lactating patients.

Recent surveys showed that pregnant women frequently consume dangerously low quantities of protein. One study showed that 447 out of 514 pregnant women, or 87 per cent, consumed less protein in their diet than the recommended amount, while the overall protein intake was 22 per cent below N.R.C. recommendations. Another study reported that from a total of 225 patients, only 3 per cent of Negro charity patients, 2 per cent of white charity patients, and 12 per cent of the private patients ingested sufficient protein.

In addition, achlorhydria, a deficiency of hydrochloric acid in the stomach is common during pregnancy and, since this condition interferes with economical utilization of the ingested protein, it can readily be seen that it would accentuate any lack of protein in the diet.

11. Old Age: Poor appetite, due to loss of teeth and new dentures, and a deficiency of hydrochloric acid in the stomach are common developments in old age. Coupled with these are food idiosyncrasies and increased susceptibility to injury. For these and other reasons, older people are serious surgical risks. Such individuals can be built up to a high level of well being by the use of a protein digest.

Lactamin is prepared from the protein lactalbumin by digestion with pork pancreas glands, thus paralleling closely the processes of digestion which take place in the human digestive tract.

Some protein hydrolysates are made from casein, but that prepared from lactalbumin, the soluble protein of whey, is richer in methionine plus cystine (the sulfur-containing amino acids) than casein. A comparison of the amino acid contents of lactalbumin and casein shows lactalbumin to excel in leucine-isoleucine, lysine, tryptophane and cystine.

The normal food requirements of the body include carbohydrates, fats, vitamins, minerals and water: these latter elements must be included in any comprehensive protein nutrition program if the digest is to do the work for which it is so eminently fitted: maintaining the body's protein level. ●

The Education of Lise Meitner

• **Summarized by Hugh C. Muldoon**

Dr. Lise Meitner, world-famous physicist and mathematician, whose scientific discoveries give her rank with Rutherford, Einstein, the Curies, Bohr, Debye, Urey and many others of great note, recently visited Pittsburgh to address the Pittsburgh Physical Society and the science teachers of the Pittsburgh Diocese. While in the city she graciously consented to address the science honor students of the Catholic high schools. This is a brief summary of her talk.

●

At a luncheon in Hotel Webster Hall, Pittsburgh, on May 3, one of the world's most famous scientists, Dr. Lise Meitner, addressed nearly 200 members of the Diocesan Honor Science Society, and told them interesting and amusing facts concerning her education. The students represented some 36 Catholic high schools of the district. Meeting Dr. Meitner was their generous reward for a year of hard and successful study. Dr. Thomas J. Quigley, Superintendent of Catholic Schools, other members of the clergy, teaching Brothers from local high schools, and distinguished representatives of all the Pittsburgh institutions of higher learning were guests.

Dr. Meitner's story began with a brief sketch of the conditions surrounding the education of women in Austria when she was young. It was not until the early years of the present century that high schools were established in Vienna where girls might be prepared for college. Before 1891, there was no school in Vienna teaching girls beyond the five years of elementary school. Consequently, college education for women in Austria was unheard of at a time when American women had long been admitted to universities. Even after high schools for girls were in operation teachers did not encourage girls to seek higher education. At the University of Vienna girls were at first admitted as candidates for degrees only in the school of philosophy, which included mathematics and the sciences. They were permitted to audit courses in the schools of law and medicine, but they could never become lawyers or physicians because the professional degrees could not be conferred upon them.

Entrance to the University of Vienna was not easy. Girls were required to pass a rigorous written examination in mathematics, physics, chemistry, Greek, Latin, German, history and geography, and an oral examination in botany, logic, psychology and language. The ordeal was made still more difficult by the fact that the examinations had to be taken, not under their own teachers, but at a school for boys under a Board, the head of which did not approve of the higher education of women.

Nevertheless, Miss Meitner succeeded in passing the entrance tests and was admitted to the University of Vienna. She was one of three girls enrolled with some 300 boys who at first were inclined to resent the feminine invasion of their domain. Eventually, they became reconciled to the situation and accepted the girls as serious students of science.

After receiving the doctorate at Vienna, Dr. Meitner went to the University of Berlin, in 1907, to continue her studies. Her reception was far from cordial. At that time certain professors refused to admit women students, however capable, to their lectures, and they were not compelled to admit them. There were no women teachers at the University of Berlin, a restriction that was not abolished until about 25 years ago.

Of this phase of her work, Dr. Meitner stated:

> "When I wanted to work with Dr. Otto Hahn as a chemistry student in order to get acquainted with chemical radioactivity, I was told by Professor Emil Fischer that women students were not generally admitted, but he added that he would not object to my working together with Hahn in a little room where Hahn carried out the measurements of radioactive substances, but that I could not take part in the chemical work. Fischer, to convey his attitude, told me that some years ago he had admitted a Russian woman as a student who had dressed her hair in such a way that she was always in danger of being set afire when she was working with the Bunsen burner. However, I would like to emphasize that when Fischer found out that I was seriously interested in the work, he changed his attitude and encouraged my work in every possible way. It was owing to his aid that I got a chemistry position at the Kaiser Wilhelm Institute in 1913. In 1917, I was charged with setting up the physics department at this institute and I was appointed the head of this department."

When Dr. Meitner sought the privilege of working under Dr. Max Planck, he was not impressed, suggesting that work beyond the Doctor's degree was for her not necessary. But four years later he honored her by appointing her his assistant in the department of physics, the first Prussian appointment of a woman to a position of this kind. Dr. Meitner stated ". . . there is no person, with the exception of my parents, to whom I am as much obliged as I am to Dr. Max Planck."

Women scientists were regarded almost as freaks by the public as well as by certain professors. The winning of a Doctor's degree by a woman might be considered somewhat of a disgrace. After Dr. Meitner became known through the publication of scientific articles, a publisher of a scientific dictionary requested

her to write an article for his book. But, surprisingly, when he learned that Dr. Meitner was a woman, he withdrew his request since he did not want to publish an article written by a woman scientist.

The resentment against women students and scientists gradually died away. After World War I, women were accepted in science, education, and government on a par with men.

Vita

The following brief sketch of the life of Dr. Meitner appeared on the souvenir menu of the luncheon. It was prepared by Sister M. Rosaire, I.H.M., St. Mary of the Mount High School, Pittsburgh, director of the Diocesan Honor Science Society:

A Vienesse, Lise Meitner was born on November 7, 1878, the daughter of a lawyer and one of seven children. She began her science studies in Vienna where she became interested in atomic physics during her first year of work. In 1908 her advanced studies brought her to Berlin, where she studied theory with the renowned German physicist, Dr. Max Planck. At this time she also began her experimental work with Dr. Otto Hahn which gave her the opportunity to study further the radioactivity of the atom.

Dr. Meitner became assistant to Planck at the University of Berlin, in which capacity she served for three years, at the same time continuing her work with Hahn. While Germany was at war, in 1917, she was charged with the organization of the department of physical radioactivity at Berlins' famous Kaiser Wilhelm Institute.

In Berlin, Dr. Meitner studied the developments in the field of research of atomic physics while conducting experiments with Hahn and Dr. Fritz Strassmann. She won a distinguished reputation for her work on the products of the disintegration of radium, thorium and actinium, on the behavior of the beta rays, and on the physics of the atomic nucleus. In 1918, together with Hahn, she discovered protactinium, a radioactive element which, by disintegration yields actinium.

In 1938, the three scientists, Meitner, Hahn and Strassmann, announced the creation of a trans-uranium element (heavier than uranium) produced by the bombardment of uranium with neutrons. Firing slow speed neutrons at the uranium nucleus produced barium. Before the mystery of the barium was solved, Dr. Meitner left Germany for Sweden. In Sweden she has been associated with the Nobel Institute in Stockholm. By the time Dr. Meitner had reached Stockholm she had solved mathematically the supposed barium mystery.

Dr. Meitner is now a visiting professor at the Catholic University, Washington, D. C. ○

Make Your Own

MICRO SLIDES

with this complete

Microtechnikit

Here's EVERYTHING you'll need, including: pre-stained sections, ready-cut sections, and prepared whole-mount materials . . . both plant and animal.

Illustrated Handbook tells how to prepare whole mounts; how to cut free-hand sections; how to stain animal and plant tissues; how to mount and finish micro slides for your permanent collection.

• • •

May we tell you more?

CAMBOSCO *Scientific Company*

3739 ANTWERP STREET BOSTON, MASS.

NEW BOOKS

Introductory Astronomy

• *By* J. B. SIDGWICK. New York: Philosophical Library, 1944. Pp. viii + 137. $2.50.

Among the books issued to satisfy war-time needs one of continuing usefulness is this small volume whose purpose is more pointedly expressed in the title of the original English edition: *Astronomy for Night Watchers.* During the war years many in England, as here in America, found themselves spending long night hours scanning the skies with binoculars on the lookout for hostile planes. It was inevitable that among these some curiosity should be aroused about the heavenly bodies observable through their binoculars, and for them this book was written to provide the basic facts of present-day astronomy and some interesting information on the more easily studied phenomena of the night skies.

The first 67 pages are devoted to brief chapters on the planets, moon, comets and meteors, stars, star clusters and nebulae. The remarks made on each are few and well chosen with a view to arousing interest and leading to further study. The remaining pages include maps of 47 constellations (apparently printed from old plates) with comments on the more interesting stars and clusters of each one. The book is not a textbook; there is no attempt at completeness; diagrams are few and there are no photographs. However, the beginner will find in its pages a clear presentation of a choice selection of elementary facts and will be particularly pleased to find specific recommendations as to what one should look for in the night skies and where. Astronomical symbols and letterings, usually so repellent to the layman, are here introduced and explained in such an orderly fashion that by the time one has finished the book they no longer offer difficulty.

Introductory Astronomy should be on the shelves of school libraries as a companion to more solid and thorough treatises. It will be especially appreciated by teachers who need a brief and simple explanation of astronomy as background for presentation of material now being introduced into school textbooks to satisfy the modern interest in aviation. Within its limited scope the book is quite satisfactory.

Rev. John P. Gallagher, C. S. Sp.

Encyclopedia of Substitutes and Synthetics

• *Edited by* MORRIS D. SCHOENGOLD. New York: Philosophical Library, Inc. 1943. Pp. 382. $10.

This is a new reference work, the first of its kind in any language. It describes new and old raw materials, chemicals, processes, substitutes and synthetics of interest to all branches of industry. Items are listed alphabetically, and the properties, solubilities, uses, and substitutes for each are given. Some 75 industrial and research organizations participated in selecting and preparing the contents of the book, ensuring excellent coverage and up-to-the-minute information.

This book is a mine of information for searchers for hard-to-get materials. It should be of great value to industrial and laboratory chemists who are seeking new and improved materials.

Charles H. Becker

Science for a Better World

• Book Nine, The Wonderworld of Science Series. *By* MORRIS MEISTER, RALPH E. KIERSTEAD AND LOIS M. SHOEMAKER. New York: Charles Scribner's Sons. 1946. $2.20.

This textbook in general science, the ninth of a series, is an outstanding contribution to science instruction in secondary schools. Its sound general plan has been carefully developed. The book is wholly modern and unusually teachable, and it does not make the mistake of underestimating the intelligence and the awareness of the average ninth grader. It should stimulate the teacher as well as the pupil, for only a well informed person will be able to answer the questions this text will raise.

Some, but not all, the material presented on such topics as the sulfa drugs, DDT, plastics, radar, television and antibiotics may be a little advanced for the general science student. Perhaps some of it will not mean much to him. The reviewer wonders whether the pupil will understand or misunderstand the molecular models shown, and if confusion may not result from using more than one type of model.

The book has ten units made up of 39 chapters. The chapter on "Science for Solving Human Problems" and the unit "Better Health Through Science" are especially well done.

The selection of material seems to be in good balance. There are many demonstrations and experiments. Each chapter contains a page of problem pictures, a list of "Things to Do" and exercises to determine "How Much Do I Remember?"

Alma Froderstrom and Thomas Voter have illustrated the book attractively with many photographs, drawings and charts, a few in color. The type selection is good. War-time restrictions on paper are still in evidence.

H. C. M.

Guiding the Normal Child

• *By* AGATHA H. BOWLEY, PH.D. New York: Philosophical Library, Inc. 1943. Pp. xv + 174. $3.00.

This volume depicts a true and vivid picture of the "whole normal child" from birth through pre-school, and through the middle years, tinted with a slight but wise psychological knowledge to help one understand the difficulties of growth and development. It concludes with a note of reassurance suggesting a worth while approach

to the solution of these ills, the growing pains of childhood.

The teacher is warned against undue anxiety and impatience in dealing with the child who confronts her with these "stop" signs on the way of development: at two—temper tantrums; at three—destructive behavior; at adolescence—a household problem.

One may be casual with this book or delve into an intensive study in the field of guidance of the normal child from the wealth of bibliography arranged at the close of each chapter.

"Most of us grownups have a good deal to learn about not interfering with this growth process, and also about helping it to proceed along lines which will result in a happy, well-adjusted individual. I think our aim, whether as teachers or parents, should be to try to develop the potentialities of a child so that he may achieve the most satisfactory personality development possible, but one which is compatible with the needs of other people in his environment."

Anna Catherine McDevitt
Graduate School
Duquesne University

German for the Scientist

• *By* PETER F. WIENER. Brooklyn, N. Y.: The Chemical Publishing Co., Inc. Pp. xxi + 238. $3.50.

Chemists or physicists who seriously want to improve their command of scientific German, with or without a teacher, might very well choose this volume to assist them.

It contains, first of all, a brief but adequate review of the indispensable elements of German grammar. This is followed by approximately 80 pages of selections in German from representative treatises on chemistry and physics bearing such authoritative names as Einstein, Born, Karrer, Ephraim, Willstätter, Nernst, and many others. An especially helpful feature is the inclusion of sections from Beilstein and other handbooks, illustrating the extensive and frequently troublesome use of a great variety of abbreviations. The selections have been carefully chosen to include the greatest number of basic scientific words and each is long enough to give the reader the "hang" of the author. A brief vocabulary of the most important words is given at the end of each selection, along with a few references to the section on grammar. A complete vocabulary is included at the end of the book.

Translations of all the German passages are included to aid the student working without a teacher. These are deliberately not strictly literal. They are certainly adequate for their intended purpose, but in some places the expression is not in the best American-English idiom, and in others the sentence structure is awkward and strongly suggestive of the original German. There are a few regrettable and usually obvious lapses from accuracy in the chemistry section. These result, in most cases, from identifying the English chemical nomenclature too closely with the German (e.g., page 147, iron potassium aluminium instead of iron potassium alum; page 170, oxy instead of hydroxy).

Whether or not teachers of scientific German will select the book for class use will probably be determined by their individual reaction to including translations of the passages. As a supplement to formal class work or for individual study it will be of unquestioned value. *T. H. D.*

STAR FINDER

A valuable aid to the student of astronomy or of navigation has been designed to locate celestial bodies quickly and accurately. The Millar Observoscope is made on the same principle as the equatorial mounting of the astronomer's telescope. This precision instrument is constructed of impact-resistant phenolic plastics with declination and latitude scales impressed in the body of the instrument. Impressed also are scales which indicate month, clock and sidereal hour angles.

Use of the instrument helps the student in visualizing the coordinate system and the apparent motion of the stars, while locating instantly the desired star. Intricate and confusing charts become unnecessary. In use, the latitude scale is set to the latitude of the observer and the civil time, opposite the day of the month. The star or constellation to be observed is looked up in the list of 55 stars provided and the sidereal hour angle set and declination indicated. The instrument is then oriented to true north and the star or constellation will be seen in the viewing tube.

The instrument may be mounted on a camera or astronomical tripod or simply placed on its weighted base for accurate observations. It may be used equally well to locate true north, to indicate civil time or latitude if all known settings are made and the sight tube is pointed to a known star. It is designed for use north of the equator. For use south of the equator, a special instrument can be supplied.

Professional astronomers who are accustomed to using complicated devices will be amazed at the accuracy and mechanical simplicity of this device.

No. 58070 Cenco Millar Observoscope Each $10.00

CENTRAL SCIENTIFIC COMPANY
Scientific CENCO Apparatus
New York BOSTON San Francisco CHICAGO Los Angeles TORONTO Montreal

Trailing Prehistoric Man

(Continued from Page 52)

the remains of a house or dwelling. In the accumulation of rubbish under this tree we found an Indian jug of beautiful contour, having upon its exterior surface a formal design of great beauty. This bit of pottery had been encircled and cracked by the roots of the pinion, but evidently it had been damaged before it was thrown upon the dump heap. In places we found holes drilled through broken sections through which in turn yucca fiber had been drawn to hold the broken parts together. Good pottery in that day was doubtless expensive. It may have been a medium of exchange.

In another place under a low overhanging cliff in "Cheese Box" canyon, we found a type of house differing in most respects from any other we had yet found. About this house there may prove to be a perfect treasure-trove of archaeological material. The structure, only the outlines of which were left standing, had been built of stulls or studding set into the sandy soil. The studding material indicated workmanship of the very crudest sort. Between the studding, as one might call it, but below the surface, we found the space filled with a kind of fiber brick made up of small sheaves of cedar bark bound into bundles two or three inches thick—maybe the first of insulated American dwellings.

The low overhanging crag under which the house was built gave a protected open cave sixty feet deep and some three hundred feet long. On the floor under this overhanging rock is an enormous mass of debris, any spot of which when excavated yielded surprising archaeological objects.

This house also had what seemed to be a flooring of cedar bark similar to the "bricks" found between the stulls.

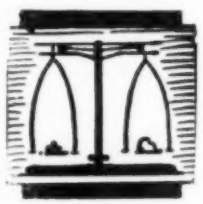
As the party traveled from point to point, sharp eyes carefully scanned the landscape, field glasses in constant use. Country rock was minutely inspected. At the shout of "Moqui", everyone piled off his horse not only to enjoy the relief from the fatigue of the saddle, but in anticipation of what new or thrilling find some member of the party had spotted. Nothing could be taken for granted lest a valuable artifact be missed. While such procedure slowed travel, it also added thrills to the hour. Indeed, each day one awoke in anticipation of some new disclosure of importance.

Usually we slept in comfort using sleeping bags and air mattresses. At Hide Out Camp, with an altitude of 8500 feet, the nights were quite cool. Plenty of blankets were needed to ward off the night chill.

The high altitude determined also the vigor of our labors. Fifteen minutes at the sifter or at the job of excavating, and the stoutest were willing, quite willing, to rest.

A radio, working intermittently, kept us more or less informed of the doings of the outside world, but for the most part we were in a world of our own, buried in the vast eternal mystery of mountain, mesa, and boulder strewn canyon.

One Sunday evening when we were stalled on the banks of the Cottonwood River waiting for a flood to subside so we might ford the stream, our temperamental radio brought us the startling news that Japan had capitulated. The canyon walls soon echoed with wild yells which may have resembled the war cries of the primitive people whose ways of life we had traveled so far to discover, and of which we had found so little and yet so much. So little had we found, indeed, yet so much had been discovered that a new field of high adventure opened up, a challenge for years of careful planning and endeavor. ●



CAROLINA CULTURES

A DEPENDABLE CULTURE SERVICE

Class of:	25	50	75	100
L 1 Giant Amoeba proteus (standard for study)	$2.00	$3.50	$4.75	$6.00
L 2 Paramecium multimicronucleatum (giant form; excellent for laboratory study)	1.50	2.50	3.25	4.00
L 60 Hydra, Green or Brown (state preference)	1.75	3.00	4.00	5.00
L 220 Planaria maculata or dorotocephala (maculata, light colored species, is generally preferred)	2.00	3.50	4.75	6.00

PRICES—AS AMOEBA:		AS PARAMECIUM:	
P. caudatum	Chlamydomonas	Euglena	Diatoms
P. aurelia	Pandorina	Arcella	Spirogyra
Stentor	Eudorina	Chilomonas	Nitella
Vorticella	Actinosphaerium	Centropyxis	Elodea
Peranema	Mixed Protozoa	Euplotes	Vinegar Eels
Volvox	Desmids	Daphnia	Rotifers
Spirostomum	Pelomyxa	Copepods	Oscillatoria

To expedite handling at transfer points in transit all living cultures are shipped **Special Delivery** same day received, or according to customer's shipping schedule. The above prices include container. Postage and Special Delivery are charged to the customer.

For Drosophila cultures, Tenebrio or "Meal-worms," Aquarium Sets or Assortments, living Frogs, Turtles, Rats, Mice, etc., see our current Catalogue.

Cultures of Bacteria and Fungi are also available. We have a complete line of Preserved Specimens, Microscope Slides, Kodachromes, Dissecting Instruments, etc. Our publication, CAROLINA TIPS, and our current catalogue will be sent free upon application.

CAROLINA BIOLOGICAL SUPPLY COMPANY
ELON COLLEGE, NORTH CAROLINA

Plants and Animals

(Continued from Page 50)

changes are exactly the reverse of those in photosynthesis. That is to say, in respiration sugar and oxygen, the two distinct products of photosynthesis, react chemically so as to release the energy stored through the photosynthetic process; and the end products of respiration, carbon dioxide and water, are in turn the two inorganic compounds which are chemically active in photosynthesis. Incidentally, we may remark here that just as photosynthesis is as yet relatively very little understood, the respiration process, too, is known to be very complex indeed. For example, a recent symposium* indicates that many enzymes are implicated in the chemical process of respiration. The over-simplified equations which are used to express the alpha and the omega of such occult chemical processes as photosynthesis and respiration should not deceive the uninitiated into thinking that biologists and chemists believe they have completely solved these problems. There is really a great difference between the two processes; because photosynthesis, however essential to life, is limited to chlorophyll-bearing plants. Respiration being an energy-releasing process, is absolutely essential to every living cell, whether plant or animal.

Growth

In the biological sense, growth is the progressive development of an organism or a part thereof, from its earliest stages to its optimum or final form. For the purpose of this discussion only the principal aspects of biological growth will be considered; such as the increase in size and number of cells and all essential changes and adjustments which are necessary to the complete development of a higher organism.

In animals, growth is proportionate throughout; that is, all parts increase in size more or less uniformly. This is not the case with the typical plant; because growth in the plant is confined to definite regions. The plant increases in size by growth and division of cells at the tips of the branches and in a limited region a little back of the tips of the roots; also through the activity of such primordia as buds; and the increase in the diameter of roots and stems is accomplished by the division of certain limited and definitely located tissue called cambium.

Animal growth, in the strict sense, continues only until a certain peak is reached. Thereafter growth ceases and decline subsequently sets in. The longest animal life span is probably represented by some of the tortoises which, according to some reports, may reach a few hundred years.

In the typical healthy perennial plant, growth continues just as long as life lasts; this, for example, in the California redwoods and some of the cycads, may be for thousands of years. Moreover, according as a tree continues to increase its spread of branches and roots, each successive season's growth is proportionately increased in mass.

Both plants and animals include many microscopic species, but the tallest giraffe is a mere dwarf by comparison with a towering redwood or a eucalyptus tree. Even the bulkiest elephant, too, is somewhat of a streamliner by contrast with the diameter of a General Sherman tree or Mexico's tree of Santa Maria del Tule.

Regeneration

Regeneration is the name given to a process by which some organisms have the potentiality to restore lost parts. Regenerative power is high in the lower animals, for example, in the flatworms and the starfishes. It decreases, however, more or less consistently as animal complexity increases. Regeneration in the animals is increasingly limited in the higher types and finally reaches a point, as in man, where very little of this power exists. Briefly, it may be said that in the animal kingdom, regenerative power is indirectly in proportion to the increased differentiation of the tissues which make up the more complex organism. On the contrary, some of the higher plants will readily regenerate whole new plant bodies from even a part of a single organ of the original plant. The new plants may arise spontaneously or from places where injury has occurred, or by experiment from organs in which incisions or wounds have been made. Such organs as the burl of a redwood, a wounded or incised begonia leaf, a cutting from a potato tuber, or a piece of the stem of a pineapple, each may give rise to an entire new plant, to mention only one example from each of several widely different and quite unrelated groups of seed plants. ●

To be continued

*A Symposium on Respiratory Enzymes, The University of Wisconsin Press, Madison, Wisc., 1942.

The Atomic Bomb

(Continued from Page 42)

If we are to avoid this immoral and stupid conduct, we must accept the new truth that now and finally the history of our world is one history—that the nations of the world have no destiny save a common destiny. The grim and solemn lesson of Hiroshima is that if we choose to live apart we shall die together. ●

Stream Pollution

(Continued from Page 46)

Unless we can conserve our soil we shall in a very short time destroy our country. The land is the keystone of our economy. One would hardly gather this from the fact that approximately 500,000 farmers are at present working land which is submarginal for crop production at any reasonably probable price level. Contrast this fact with the millions of tons of rich organic fertilizer we are wasting through failure to recover.

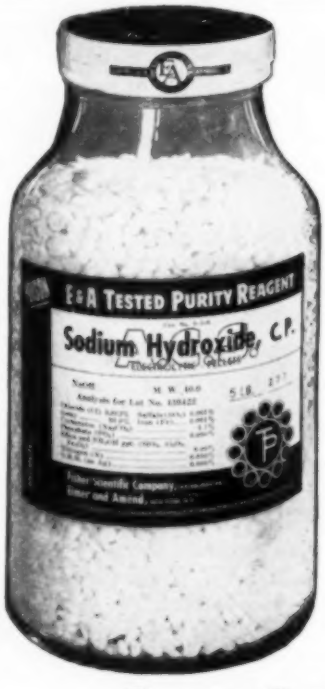
It is not improbable that within our lifetime we shall know the meaning of famine, and we shall know that this famine came to us because of the disappearance of our top soil and the steadily decreasing fertility of the remainder because of the lack of adequate organic fertilizer. Yes, we may even die of malnutrition if we have not already succumbed to some loathsome disease contracted from polluted water.

Which shall it be: Shall we increase the wealth of our nation or the verdancy of our graveyards? ●

Science Projects

(Continued from Page 44)

Our student winner of last year was anxious to have an entry in the Fair also, so I agreed to sponsor a project on plant taxonomy for her. She constructed a simple background divided into four panels in which she displayed representatives of four plant phyla. The panels were subdivided to include a specimen of each class. The plants, the smaller ones preserved in formalin, and the larger, dry-mounted, made up the exhibit. Water-color sketches of the plants and printed labels indicated the distinguishing characteristics of each phylum and class. The protococcus was easily obtained from a tree in the park, and the spirogyra, from the laboratory supply kept on hand for microscopic work. Cultures of bacteria, yeast, and bread-mold were prepared in the laboratory, but had to be renewed periodically during the Fair. The fruited moss, and liverwort were espied around the base of some potted plants at the Phipp Conservatory, and with the kind permission of the curator we took samples of both. In the pteridophyta, dry-mounted specimens of plants collected in the early fall were used. The gymnosperms were easily procured at Schenley Park, while the monocot and dicot angiosperms were another of our laboratory assignments. This exhibit, too, I believe, will serve as a graphic outline of the plant kingdom for classroom instruction.



EIMER and AMEND "T. P." REAGENTS

★ MEET A.C.S. SPECIFICATIONS

★ BEAR ACTUAL-ANALYSIS LABELS

Eimer and Amond Tested Purity Reagents were the first in America to bear labels stating the exact amount of impurities—not merely maximum limits. They have become standards of purity in analytical laboratories throughout the country.

These reagents are available along with scientific instruments, modern laboratory apparatus and special chemicals from these conveniently-located distribution centers:

Manufacturers—Distributors

FISHER SCIENTIFIC CO.
717 Forbes St., **Pittsburgh (19), Pa.**
2109 Locust St., **St. Louis (3), Mo.**

EIMER AND AMEND
Greenwich and Morton Streets
New York (14), New York

Headquarters for Laboratory Supplies

If our repeated successes as exhibitors have been at all unusual, it may be attributed to two factors: first, that in all our projects we endeavored to follow explicitly the suggestions furnished by the Buhl Planetarium, one of the cosponsors of the Science Fair, namely, that the exhibit should teach the general public something about science hitherto unknown; and that the exhibit's story should be clear, brief, and legible. The second factor was the enthusiasm of our science students themselves, demonstrated by the hundreds of original scientific creations exhibited at the annual science fairs.

The foundation of scientific learning unquestionably is begun in the high school. With our civic organizations aiding in discovering this latent ability, and our government and institutions of higher learning financing scientific education and technical training, we shall have the constant supply of research scientists that are needed to raise our standard of living and assure our national security. ●

An Experienced Principal

Said to her teachers:

- You should put snap into the handling of routine matters.
- You are solely responsible for seeing that lessons are prepared. You must check every lesson, look at the written papers, and give fact tests for studied material.
- If lessons are unprepared, you must see to it that the student makes up the work. Set your own penalty.
- Do not state or infer that any class or any subject is either superior or inferior in any way to any other class or subject.
- As a part of your first week's work you must teach the use of index and table of contents, use of paragraph headings, and reading for the answer to definite questions.
- Finish a unit before you leave it, and know by testing that it has been learned.
- In developing, never tell key facts. Question until you get them.

Was the Principal right?

Mystery--- or Mastery?

Are some of your beginners baffled by chemical hieroglyphics? Or do they really comprehend the language of symbols and subscripts?

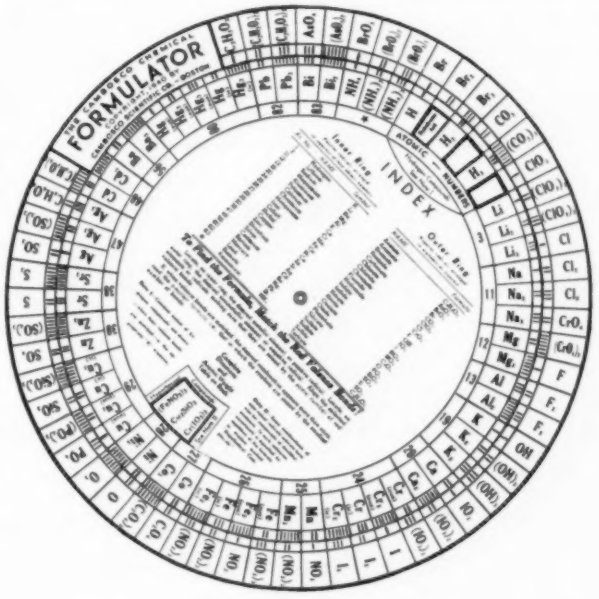
In hundreds of American schools and colleges, thousands of chemistry students have **mastered** the mysteries of formula writing—thanks to the CamboscO Chemical Formulator.

This ingenious, self-teaching device works like a circular slide rule. It shows correct formulas for more than five hundred chemical compounds.

Each use of the Formulator reminds the beginner that, as elements are united to form compounds, so symbols may be combined to provide formulas which designate (and suggest the composition of) those compounds.

Ipso facto, the concept of valence is clarified; the approach to balanced equations is simplified.

The Formulator, with symbols in black and valence bonds in red, is die-stamped from tough card stock. Diameter, 7 in.



A Postpaid Sample will be sent on receipt of thirty cents.

Cat. No. 25430 • *Each,* $. 30 • *Dozen,* $2.40

Cambosco SCIENTIFIC COMPANY

3739 ANTWERP STREET • Boston, Mass., U. S. A.

Stream Pollution

(Continued from Page 46)

Unless we can conserve our soil we shall in a very short time destroy our country. The land is the keystone of our economy. One would hardly gather this from the fact that approximately 500,000 farmers are at present working land which is submarginal for crop production at any reasonably probable price level. Contrast this fact with the millions of tons of rich organic fertilizer we are wasting through failure to recover.

It is not improbable that within our lifetime we shall know the meaning of famine, and we shall know that this famine came to us because of the disappearance of our top soil and the steadily decreasing fertility of the remainder because of the lack of adequate organic fertilizer. Yes, we may even die of malnutrition if we have not already succumbed to some loathsome disease contracted from polluted water.

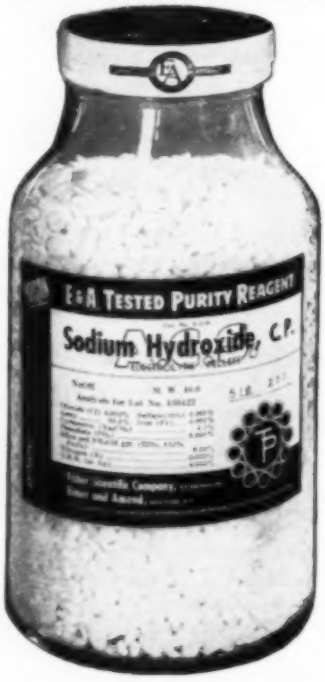
Which shall it be: Shall we increase the wealth of our nation or the verdancy of our graveyards? ●

●

Science Projects

(Continued from Page 44)

Our student winner of last year was anxious to have an entry in the Fair also, so I agreed to sponsor a project on plant taxonomy for her. She constructed a simple background divided into four panels in which she displayed representatives of four plant phyla. The panels were subdivided to include a specimen of each class. The plants, the smaller ones preserved in formalin, and the larger, dry-mounted, made up the exhibit. Water-color sketches of the plants and printed labels indicated the distinguishing characteristics of each phylum and class. The protococcus was easily obtained from a tree in the park, and the spirogyra, from the laboratory supply kept on hand for microscopic work. Cultures of bacteria, yeast, and bread-mold were prepared in the laboratory, but had to be renewed periodically during the Fair. The fruited moss, and liverwort were espied around the base of some potted plants at the Phipp Conservatory, and with the kind permission of the curator we took samples of both. In the pteridophyta, dry-mounted specimens of plants collected in the early fall were used. The gymnosperms were easily procured at Schenley Park, while the monocot and dicot angiosperms were another of our laboratory assignments. This exhibit, too, I believe, will serve as a graphic outline of the plant kingdom for classroom instruction.



EIMER and AMEND "T. P." REAGENTS

★ MEET A.C.S. SPECIFICATIONS

★ BEAR ACTUAL-ANALYSIS LABELS

Eimer and Amend Tested Purity Reagents were the first in America to bear labels stating the exact amount of impurities—not merely maximum limits. They have become standards of purity in analytical laboratories throughout the country.

These reagents are available along with scientific instruments, modern laboratory apparatus and special chemicals from these conveniently-located distribution centers:

Manufacturers—Distributors

FISHER SCIENTIFIC CO.
717 Forbes St., **Pittsburgh (19), Pa.**
2109 Locust St., **St. Louis (3), Mo.**

EIMER AND AMEND
Greenwich and Morton Streets
New York (14), New York

Headquarters for Laboratory Supplies

If our repeated successes as exhibitors have been at all unusual, it may be attributed to two factors: first, that in all our projects we endeavored to follow explicitly the suggestions furnished by the Buhl Planetarium, one of the cosponsors of the Science Fair, namely, that the exhibit should teach the general public something about science hitherto unknown; and that the exhibit's story should be clear, brief, and legible. The second factor was the enthusiasm of our science students themselves, demonstrated by the hundreds of original scientific creations exhibited at the annual science fairs.

The foundation of scientific learning unquestionably is begun in the high school. With our civic organizations aiding in discovering this latent ability, and our government and institutions of higher learning financing scientific education and technical training, we shall have the constant supply of research scientists that are needed to raise our standard of living and assure our national security. ●

An Experienced Principal

Said to her teachers:

- You should put snap into the handling of routine matters.
- You are solely responsible for seeing that lessons are prepared. You must check every lesson, look at the written papers, and give fact tests for studied material.
- If lessons are unprepared, you must see to it that the student makes up the work. Set your own penalty.
- Do not state or infer that any class or any subject is either superior or inferior in any way to any other class or subject.
- As a part of your first week's work you must teach the use of index and table of contents, use of paragraph headings, and reading for the answer to definite questions.
- Finish a unit before you leave it, and know by testing that it has been learned.
- In developing, never tell key facts. Question until you get them.

Was the Principal right?

Mystery--- or Mastery?

Are some of your beginners baffled by chemical hieroglyphics? Or do they really comprehend the language of symbols and subscripts?

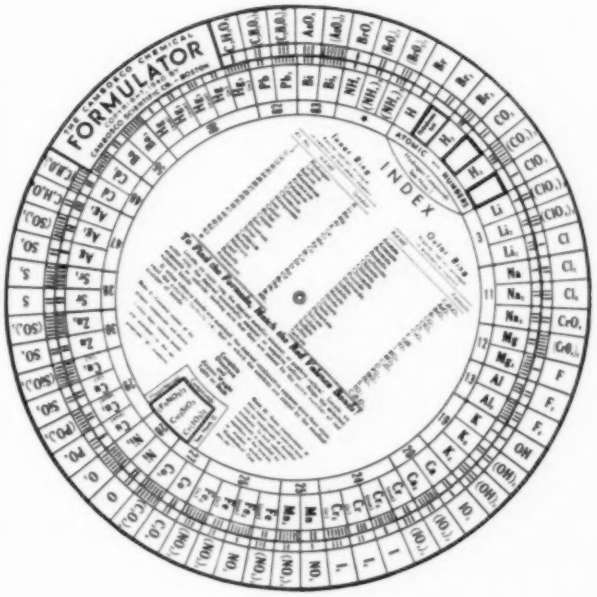
In hundreds of American schools and colleges, thousands of chemistry students have **mastered** the mysteries of formula writing—thanks to the CamboscO Chemical Formulator.

This ingenious, self-teaching device works like a circular slide rule. It shows correct formulas for more than five hundred chemical compounds.

Each use of the Formulator reminds the beginner that, as elements are united to form compounds, so symbols may be combined to provide formulas which designate (and suggest the composition of) those compounds.

Ipso facto, the concept of valence is clarified; the approach to balanced equations is simplified.

The Formulator, with symbols in black and valence bonds in red, is die-stamped from tough card stock. Diameter, 7 in.



A Postpaid Sample will be sent on receipt of thirty cents.

Cat. No. 25430 • *Each,* $. 30 • *Dozen,* $2.40

Cambosco SCIENTIFIC COMPANY

3739 ANTWERP STREET • Boston, Mass., U. S. A.

Pointers for the Classroom Teacher

If papers are being checked, *concentrate on checking.* Don't do anything else. Discussion and questions should follow.

●

Questions by students are a sign that the work is getting over, at any rate to a certain degree. *They should be answered,* or at least acknowledged. The teacher who pays no attention to a pupil with upraised hand is inexcusably discourteous. It is all right to say, "I don't want to answer any questions until this explanation is finished; save your questions just a minute." But to look at a pupil and deliberately ignore his question is inexcusable.

●

Use two kinds of questions: (1) *fact* questions, and (2) *thought* or *power* questions.

(1) The most efficient way of checking knowledge of *facts* is by using fact tests, to be answered in single words or phrases. Teachers cannot prepare good fact tests *in class.* They must be made when there is ample time to word them accurately. They should cover essential fundamental facts, not small details. No question is repeated. Only a brief time for answering is permitted. Pupils exchange papers. The *teacher* reads the answers. No discussion is allowed during the marking.

The fact test is valuable because it tests *every pupil's* preparation in a brief time. The same kind of test is given by rapid fire drill around the class, but the whole class is not tested.

(2) Power questions can be handled by oral recitation, or by written answers at the blackboard. The latter plan is to be preferred if good technique is used. This procedure works well: (a) Assign the questions before the students pass to the board. (b) Give each pupil plenty of board room. (c) Limit the time *strictly.* (d) The pupils return to their seats at the signal whether they are finished or not. (e) Beginning at one end, go around the board having the pupil who wrote the answer, *read* it. The class criticizes. The teacher supplements the criticism if necessary, and then marks the standing.

Advantages: No student can bluff. Every pupil gets the benefit of *every* criticism, and there is ample discussion. Daily marks are possible. The preparation of students improves since they dislike getting low marks. Because all students are concentrating on the board, the class order is better. The students who recite get the facts through ear, eye and muscles; so impressions are stronger. If the teacher pays proper attention to form, there is a noticeable improvement in English.

●

Plan your work—what you are going to do, but more especially *how* you are going to do it. Then, work your plan.

THE SCIENCE COUNSELOR

SUBSCRIPTION ORDER

The Science Counselor
901 Vickroy Street
Pittsburgh, Pa.

Enclosed is $..... Please enter my subscription to THE SCIENCE COUNSELOR as checked:

☐ 1 Year - $1.00 ☐ 2 Years - $2.00 ☐ 5 Years - $5.00

SIGNED.....

.....

PLEASE PRINT NAME AND ADDRESS.....

DUQUESNE UNIVERSITY

PITTSBURGH

•

THE GRADUATE SCHOOL • THE SCHOOL OF LAW • THE COLLEGE OF LIBERAL ARTS AND SCIENCES • THE SCHOOL OF EDUCATION • THE SCHOOL OF PHARMACY • THE SCHOOL OF BUSINESS ADMINISTRATION • THE SCHOOL OF MUSIC • THE SCHOOL OF NURSING

Catalog Upon Request
Address the Registrar

Pittsburgh's Skyline University